NOVEMBER 1963 35 CENTS

Popular Science

Monthly

Compact Cars BIGGER— and Better?

PAGE 53

First automatic car-weather control

PAGE 66

Complete Guide to stationary POWER TOOLS

New quick-change Shopsmith— see personal use report

PAGE 114

Dr. Wernher von Braun on Solid vs. Liquid Rockets

How to get started with HI-FI KITS

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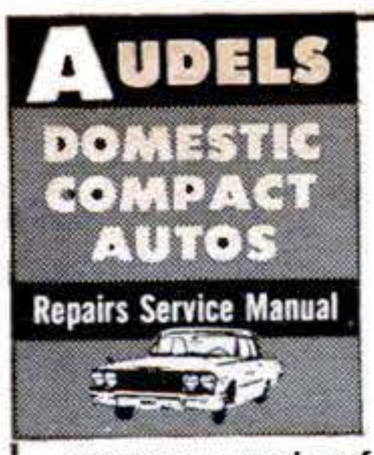

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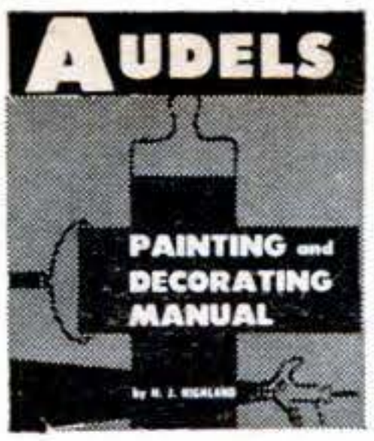

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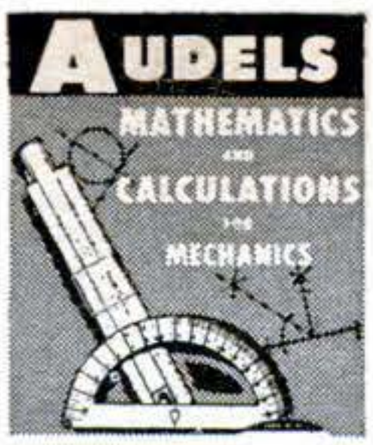

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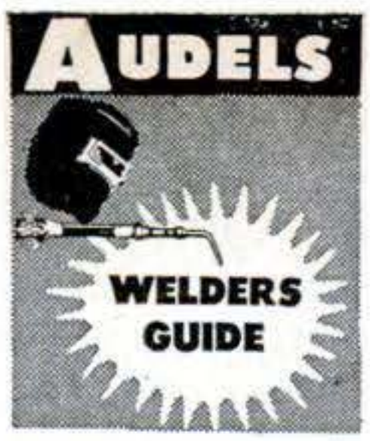

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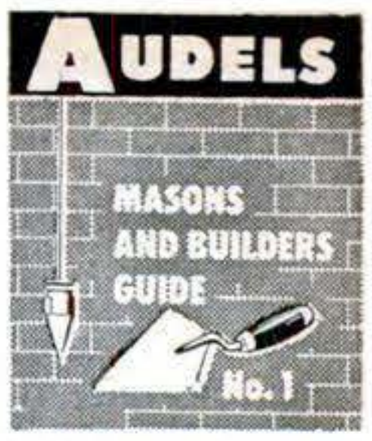

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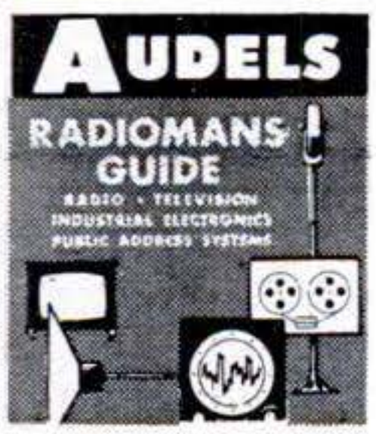

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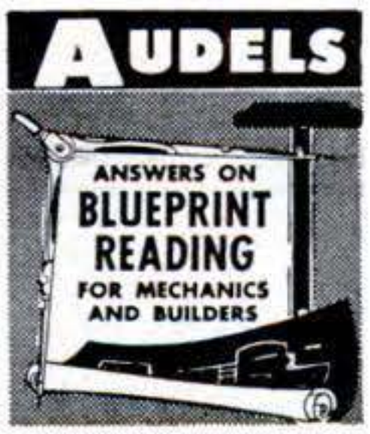

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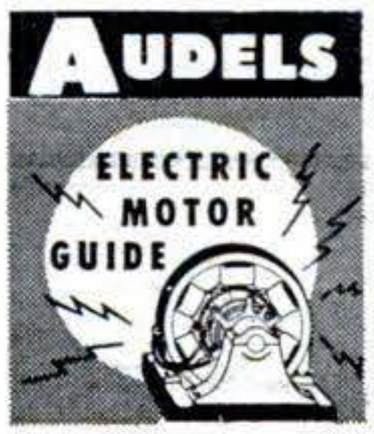

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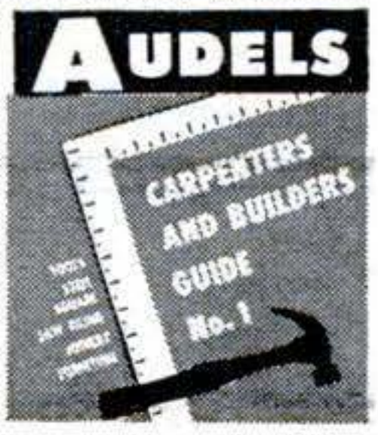

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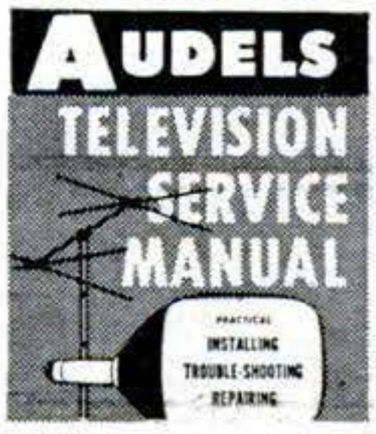

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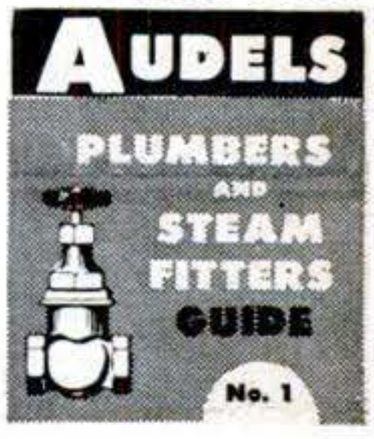

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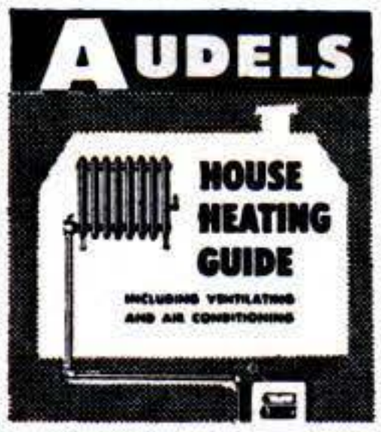

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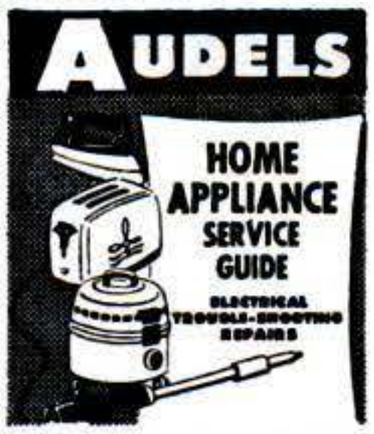

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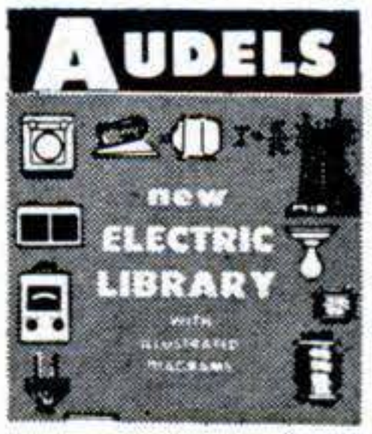

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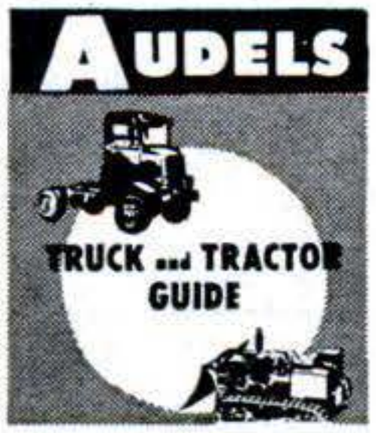

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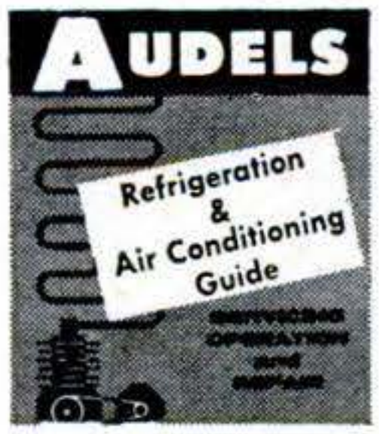

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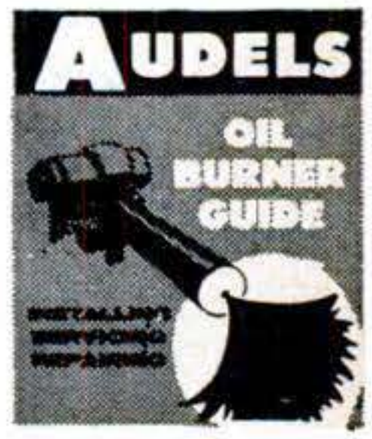

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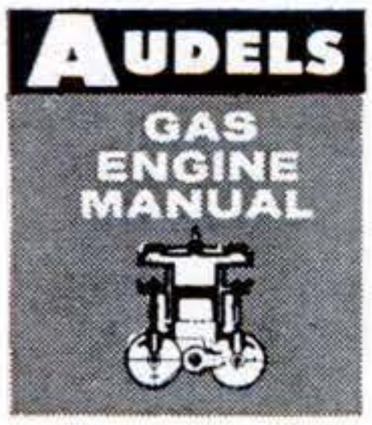

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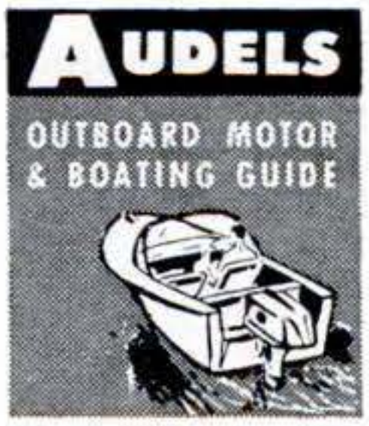

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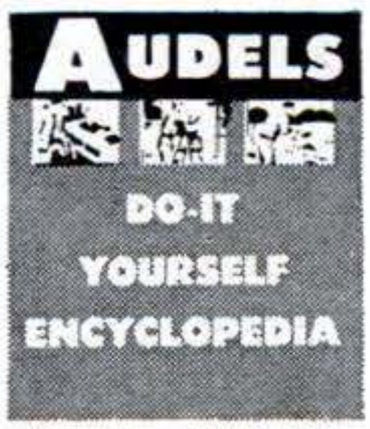

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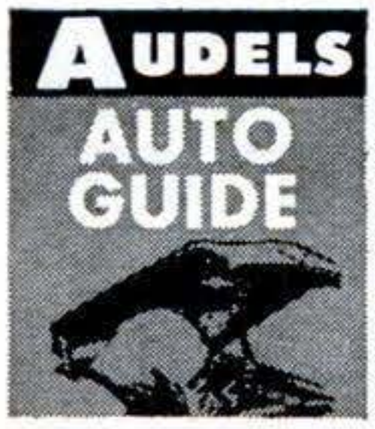

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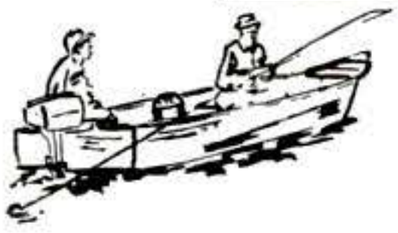

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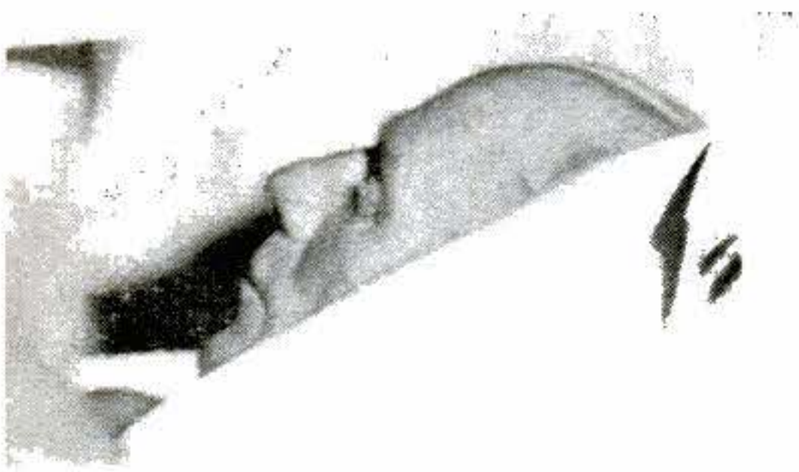
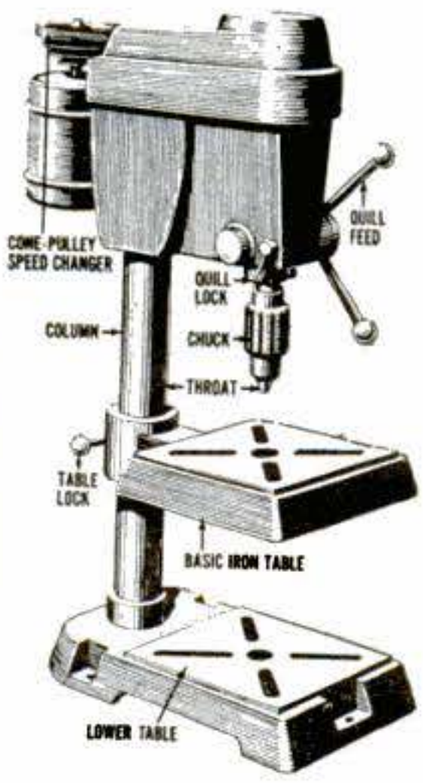
Bill Morris, J. S. Flannery
November 1963

Up go the little cars —in size, horsepower, performance, gimmicks. A critical survey by PS's Auto Editor. Page 53.



Can Leo Durocher's experience with penicillin happen to you? Page 98.



In the market for stationary tools? Here's our look-before-you-leap buyer's guide, chock full of facts and figures, sketches and specs, compiled by PS experts for the home-shop man. Page 157.

CARS AND DRIVING

Detroit Report · 50
Where Has My Little Car Gone? · 53
. . . This One's Gone to the Races · 55
IMP—Crawl-Anywhere Car · 58
'64 Cadillac Makes Its Own Weather · 66

SCIENCE AND INVENTIONS

Science Newsfront · 21
Typewriter Has Battery, Will Travel · 34
World's Fair Ride Gets Test Drive · 69
Taking the Fun Out of Getting Killed · 74
Is This Tomorrow's Man? · 77
Run Our Railroads Like the French? · 82
Automated Yard Builds Ships Indoors · 96
Wonder Drugs—Cure or . . .? · 98
Rugged New Low-Cost Microscopes · 137

SPACE AND AVIATION

Dr. von Braun: Solid vs. Liquid Fuel · 61
Wingless Bird Glides in Space · 64
The Weather Eye That Never Blinks · 70
Danger: Birds on the Runway! · 90
VTO Plane Zooms to 460 m.p.h. · 104

PHOTOGRAPHY

Catch a Falling Star? · 118
Photographically Speaking · 127
Easy-Loading Movie Cameras · 128

Contents continued on page 6

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Know all the truth about people! Now hidden secrets can be uncovered by Graphoanalysis (scientific handwriting analysis)

MODERN psychology shows you the way to use Graphoanalysis* to "read between the lines" and see people as they really are—with their masks off.

Learn how to identify character and personality traits from letters, notes, signatures and any other handwritten material.

Graphoanalysis is now being widely used by employment agencies and personnel departments to get "behind" the formal applications. Clergymen and teachers are finding Graphoanalysis valuable for gaining a deeper insight into people for more effective counseling.

Lawyers and law enforcement officials analyze handwritten messages to find out things the messages do not say—or intentionally try to conceal.

Credit departments are now more successful in weeding out bad credit risks before trouble starts. And when accounts later turn into problems the credit manager knows better how to handle the people involved after he studies the handwriting.

Personal and individual uses of Graphoanalysis are for some people of greatest importance. Newly marrieds learn to adjust by understanding each other more clearly. Parents find Graphoanalysis invaluable in helping them understand and guide their children. And many intelligent people, with or without problems, Graphoanalyze their own handwriting in order to see themselves objectively.

Maybe you have never heard of Graphoanalysis as it is a relatively new psychological technique. So it should be explained that Graphoanalysis is *not* occult graphology and has nothing at all to do with fortune-telling. It is a rapidly growing scientific procedure, already proved and tested.

Its growth during the past few years has been spectacular, even exceeding the growth of other forms of psychological testing, which have been amazing. Graphoanalysis has been written up in *Newsweek, Business Week,* American Management Association's *Personnel, Insiders' Newsletter, Insurance Salesman, London (England) Telegraph,* and other highly regarded publications.

Even the full CBS-TV network gave time to a serious explanation of Graphoanalysis, its scientific background and its many uses in business and the professions.

What does all this mean to you?

First of all here is your chance to acquire a specialized knowledge that will help you personally in a hundred different ways. Secondly, you can almost certainly use the techniques of Graphoanalysis to advance yourself in your present occupation.

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SPECIAL PS BUYER'S GUIDE
PART I: STATIONARY POWER TOOLS
Table Saw: Basic Cutting Tool • 159
Radial-Arm Saw Is Whole Shop • 162
Drill Press—Job-Hungry Tool • 166
Power Sanders: The Three Types • 168
Jigsaw Thrives on Fancy Cuts • 172
Bandsaw for Rugged Contouring • 174
Wood Lathe Widens Your Skills • 176
Metal Lathe—a New Excitement • 178
Jointer-Planer Makes Pieces Fit • 180
Shaper for a Professional Look • 182

HOME AND SHOP
Quick-Change Seesaw Shopsmith • 114
So—I Built My Own Fireplace • 129
Make a Glass-Cutting Board • 132
Water Pipe on the Rocks • 133
Shop Talk • 144

SPECIAL PROJECT
Gas-Powered Snow-Trac • 122

BOATS AND BOATING
Jim Roe Pre-Tests '64 Outboards • 106

ELECTRONICS
Building Hi-Fi Kits • 138

AUTO REPAIRS
Hints from the Model Garage • 146
Gus Warms Up a Cold Customer • 150

PICTURE NEWS
Wire Mesh Makes Monkey's Cage • 87
40-G Sled Simulates Car Crash • 88
Prefabricated Brick Walls • 97
Synthetic Racetrack—No Mud • 104

SHORT CUTS AND TIPS
Long-Lasting Bandsaw Tire • 113
Tools in Shelf Edge Save Space • 126
Easy-to-Make Binocular Rack • 134

EVERY MONTH
PS Readers Talk Back • 6
Getting Ahead • 28
90, 60, 30 Years Ago • 50B
New Ideas from the Inventors • 94
I'd Like to See Them Make • 103
Wordless Workshop • 112

PS readers talk back

Ruffled Fenders

In "How to Get a Good Body-Repair Job" [Sept.] it looks to me like two different Ramblers were used for the before and after photos. One car has blackwall tires and a standard gas cap and the other is pictured with whitewalls and a chrome gas cap.

ROBERT SILLMAN, Oceanside, N.Y.

The gas cap was lost at the time of the accident and a kindly gas-station man slapped on a spare (not even a Rambler cap). As for the tires, the blackwalls are snow tires. The accident happened just before the white sidewalls were put on for spring, and the "after" photo was taken with these in place.

. . . After 21 days and a $300 repair bill my '60 Corvette was supposedly ready. I found pits in the body and the paint job, a misfitted headlight, and a misaligned door. To top it all off, the grille was in upside-down. After three

trips back trying to straighten things out, I decided I could have done just as good a job myself. Later, the fender was cracked again from front to rear. This time I bought a fiberglass repair kit and some matching spray paint and did the repair for $13 in my spare time. Do it yourself to do it right, is my philosophy.

ROGER BASS, Dallas, Tex.

More Think-Talk on Speed

"The Fine Art of Fast Driving" [Aug.] by David Scott is a fine commentary on the English point of view, one that has helped that country produce some of the world's best racing drivers.

As a licensed competition driver (one of fewer than 4,000 in the U.S.), I feel you should have warned drivers that many of the techniques, if not illegal, are downright suicidal on our crowded highways. The driving described demands the highest level of concentration (hence, the think-talk training) and precludes any distraction (listening to a radio, lighting an occasional cigarette, conversing

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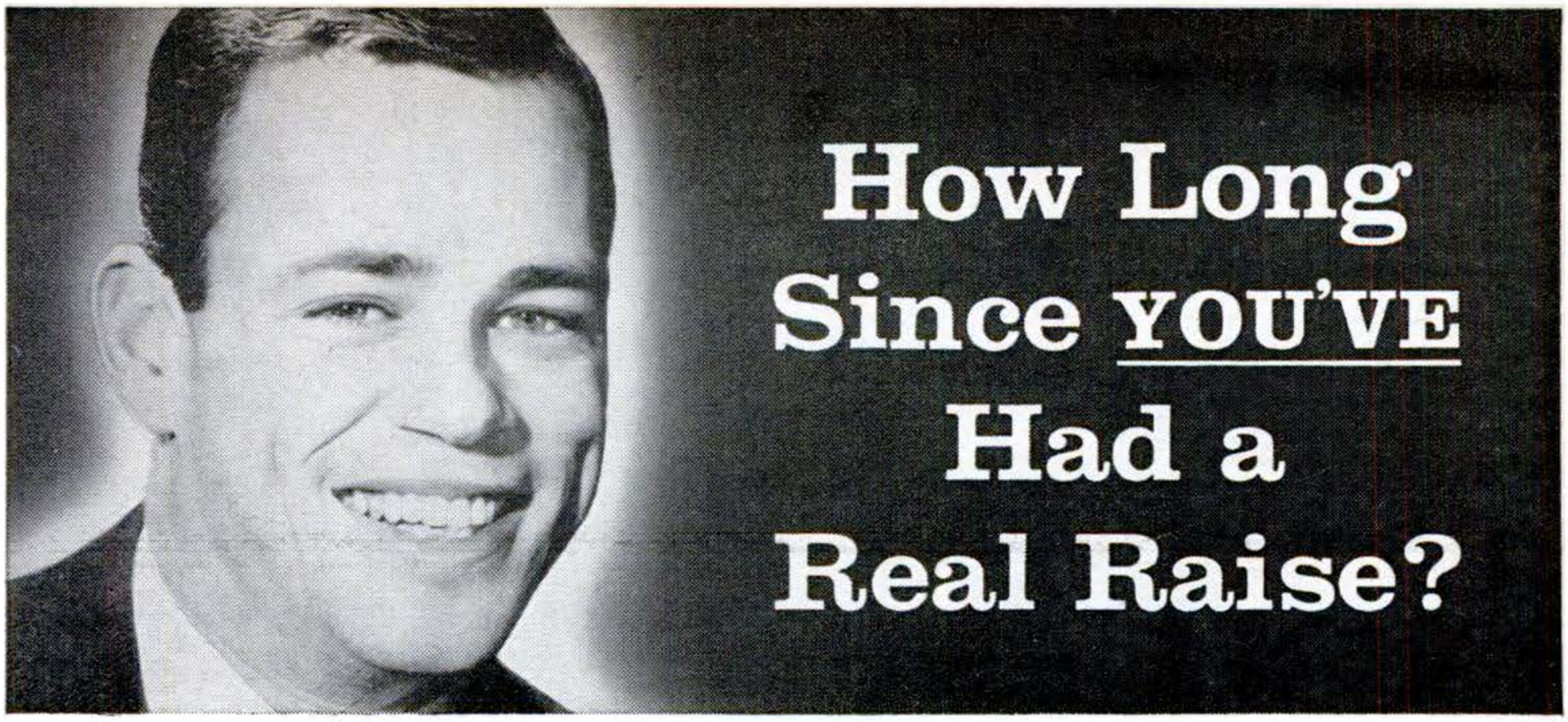

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"Salary is double what I earned when I enrolled, thanks to the opportunity you offered." — Robt. Hughes, CPA, Costa Mesa, Cal.

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Address.....County.....

City & Zone.....State.....

Occupation.....Working Hours.....A.M.....P.M.

335

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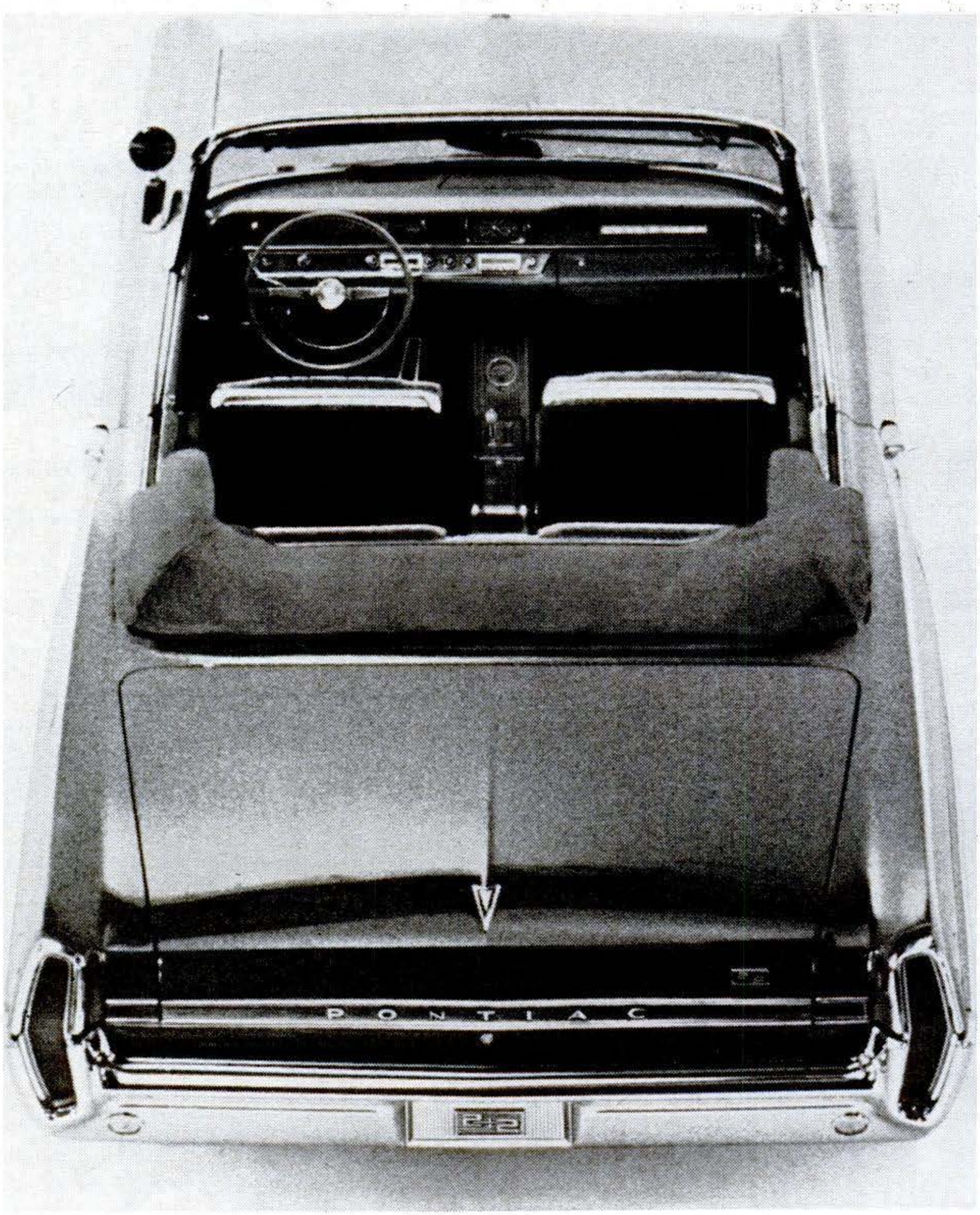
A couple of terrible things just



Pity the poor men who turn out other brands of cars and then have to look at something like our '64 Catalina 2+2, say we happily. (Not that looks are everything, you understand, but you don't catch us hiding Pontiac's power team under a ho-hum body.)

The 2+2 commences proceedings with a high compression 283-horse 389-incher for the 4-speed box (267 bhp with Hydra-Matic), but there's nothing to stop you from playing footsie with one of our three 421-inchers*. Take your pick—320, 350 and 370 bhp at your command. Available only with optional at extra-cost 4-speed or Hydra-Matic, with the shift in a central console.

There are two of these cars—sports coupe and convertible—both with bucket seats and both with their own individual interior styling.

Considering the range of options and accessories we've got, no two 2+2's need be alike. Know just the kind of car you want? Put it on paper for your Pontiac dealer and we'll turn it into metal.

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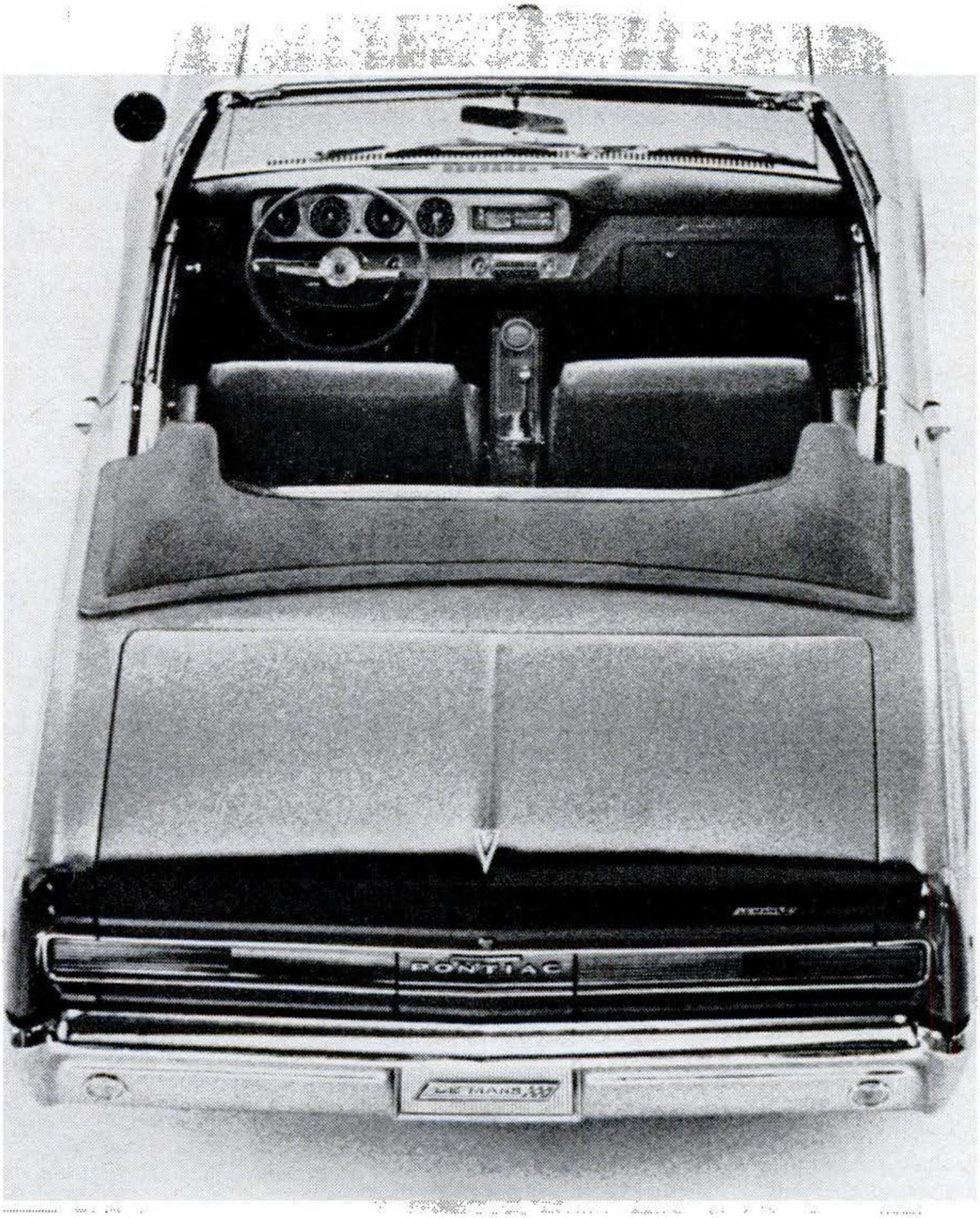
happened to our competitors.



Ask us what's new with Le Mans (and every Tempest) for '64 and we'll pour you an earful.

Take engines: the standard plant is now an in-line 6 of 215 inches and 140 horses—and there's a duo of 326-inch V-8s* at 250 and 280 horses.

Frame?—It's a new swept-hip perimeter Pontiac type.

Suspension?—Pontiac-type 4-coil, independent front, 4-link rear.

Options?—Tempest is a Pontiac, right? And Pontiac is noted for its options, right? So naturally, there's everything from a 4-speed* for both 6 and V-8s to a limited-slip differential* with a staggering array of no-extra-cost axle ratios.

Anything else? Not much, unless you count bigger brakes . . . longer, 115" wheelbase . . . larger gas tank . . . new steering gear . . . curved side glass . . . and so on. And on. (And on.)

*optional at extra cost

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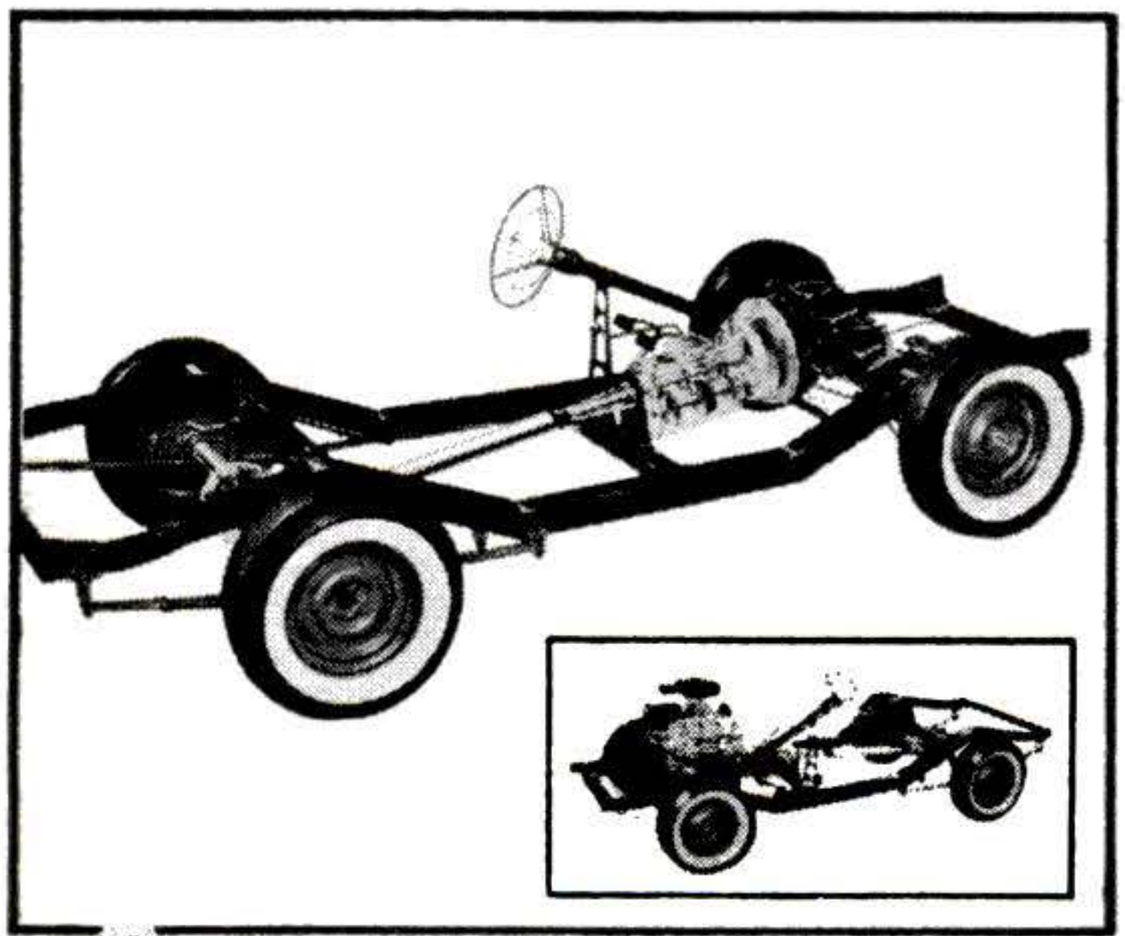
EVEN A MASTER MECHANIC COULD LEARN A THING OR TWO

by building these amazing "Visible" hobby kits.



You probably know the Renwal Visible V-8, the most accurately detailed ¼ scale automotive engine kit ever produced. Now, Renwal introduces the VISIBLE CHASSIS, over three feet long, with the same superb engineering that made the Visible V-8 a hobbyist's favorite. Everything works: Shift and watch the gears slide into position. Turn the wheel, and learn how the steering system and suspension operate. No detail was omitted. And thanks to Renwal's famous "Visible" construction, you see the "inside story." The Visible Chassis comes complete with battery driven motor, and parts for installation of the Visible V-8. By itself, the Visible Chassis is an amazingly realistic hobby kit. With the Visible V-8, it's a complete automotive education. Visible Chassis $19.95, Visible V-8 $10.95, Chassis and V-8 Set $29.95.

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with passengers). It also excludes driving when tired or emotionally upset, or after taking alcohol or mental stimulant or depressant (i.e., tranquilizers). The driver is assumed to have 100,000 miles of basic driving under all conditions, good eyesight, quick reflexes, a good sense of balance and timing, and good depth perception. The car must be in excellent mechanical condition—tires, steering, suspension. In fact, for any high-speed touring at all, the tires on almost all American cars should be replaced with a type designed to give the best control and adhesion, and not set up a standing wave at high speeds.

My hat is off to David Scott for driving the car he did, at the speeds he did, on the roads he did—and without a seat belt. It just goes to show what your writers will do for a good article.

CHARLES M. STEIN, Lock Haven, Pa.

. . . "In turning a right corner, swing out to the center of the road so you get a better view of the road around the corner, and to increase the radius of the turn."

That may be the way to drive in merrie olde England, but don't try it on US 6 through Indiana. You may wind up with a face full of semi.

BOB ADAMS, Kendallville, Ind.

Chemist Sets Record Straight

In the piece about krypton tetrafluoride ["Science Newsfront," Aug.], you mention Prof. Booth's researches on fluorine compounds of the noble gases, reported in a 1936 PS, and ask: "So what's knew about these (current) discoveries?"

Since 1936, it has become sadly apparent that Booth's argon-boron trifluoride compounds probably do not exist. His reports were based on dubious interpretation of physical properties of Ar-BF_3 mixtures, and he did not isolate or analyze any distinct compounds. Many others have tried since to repeat his experiments, but without success.

The significance of the new discoveries is at least two-fold:

1) Scores of independent workers have synthesized the new compounds, leaving no doubt as to their existence and properties. XeF_4 has even been offered for sale at $85 per gram.

2) In these new compounds, the bonding between the inert gas atoms and fluorine atoms is a very different sort than was proposed by Booth for his "compounds." The exact details

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of the bonding are still under active discussion, and new experiments continue to supply facts that theorizing must explain.

Booth's experiments and recent successes demonstrate that chemists *have* seriously wondered for many years about the apparent inertness of the noble gases. We have simply lacked evidence to confirm or disprove these suspicions. These are indeed very exciting days—not because chemistry teachers have been proven wrong, but because a whole group of new compounds is available to extend and test our understanding of chemical bonding and reactivity.

J. L. Jones, Syracuse, N.Y.

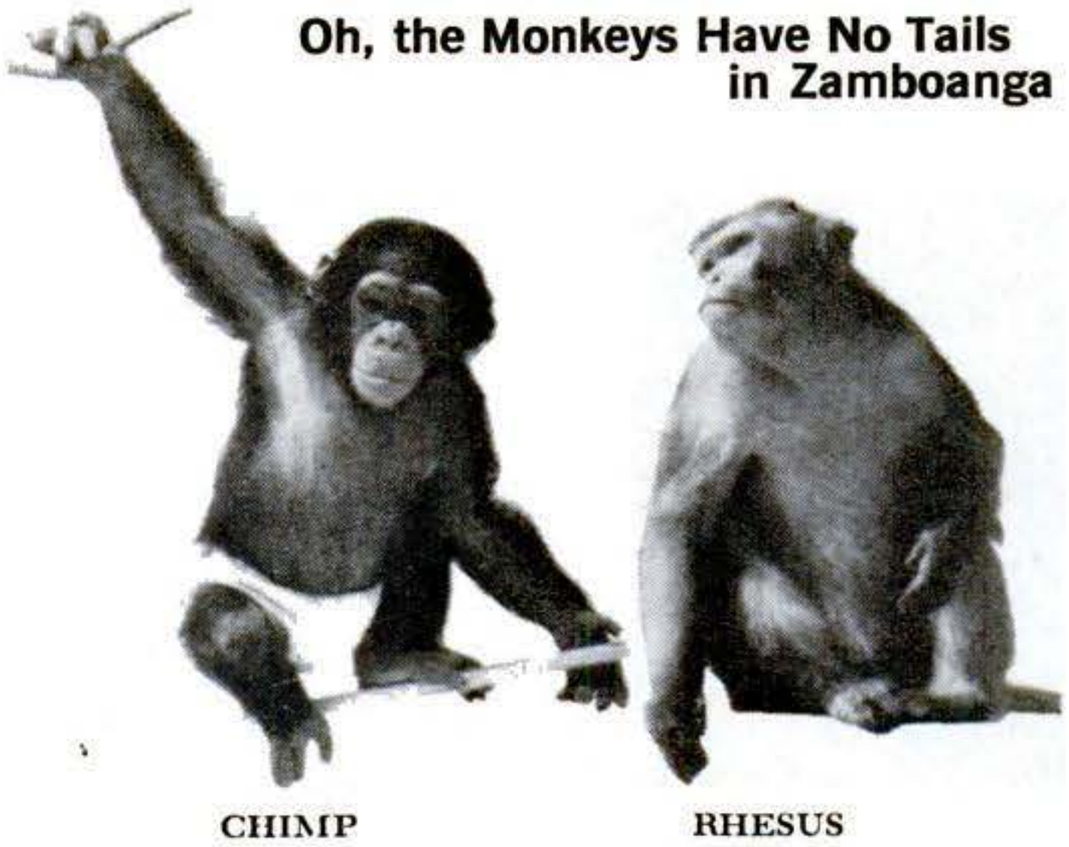
Bigger Families—More Shop Room

"Big Ideas for Improving Your Shop and Home" [Sept.] are fine for older homes but for the modern house your ideas are too big. The younger generation runs off and buys just what it can fit into, and worries about space problems later. I have a cellar workshop and 7′-by-8′ radio-TV shop, and I'm constantly hearing comments from visitors on the lack of room in the new houses.

Peter Legon, Malden, Mass.

The trend in the last five years has been toward much larger new homes—more bedrooms, large basements, double garages.

Oh, the Monkeys Have No Tails in Zamboanga



CHIMP RHESUS

In re your booboo on page 60, September ["Monkey Business in Oregon"], I suggest all concerned spend the coming weekend in the ape house at your local zoo. That's a chimp in your picture, not a rhesus monkey.

George R. Clark, Fort Worth.

Better Tires—Hold Outs?

I have read many times that the reason for the Indy races ["From Track to Turnpike," Sept.] is to try out new materials so that car makers can make passenger cars better and

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- Insure maximum gas economy and quiet engine running. Read the exact RPM while the engine is in neutral position. Then adjust the carburetor in conformity with the car manufacturer's recommendations.
- To locate a "miss" you need only disconnect or "short" the spark plugs one at a time with the Model AT-162 switched to the Tachometer position.
- Cars with automatic transmissions function efficiently only if the fluid pressures are correctly maintained and since manufacturer's instructions always refer to RPM, the Model AT-162 (or an equivalent tachometer) is required to properly service automatic transmissions.

Specifications

The Model AT-162 provides three dwell angle scales; 0 to 45 degrees, 0 to 60 degrees, and 0 to 90 degrees. The three dwell angle ranges specified above make this instrument suitable for making accurate dwell angle adjustments on all 4 cylinder, 6 cylinder, and 8 cylinder cars, both foreign and domestic.

The dual range tachometer is extremely versatile since it provides both a low range of 0 to 1000 RPM, necessary for making precise carburetor adjustments and the high range tachometer, 0 to 5000 RPM suitable for making all other tests at high engine speeds.

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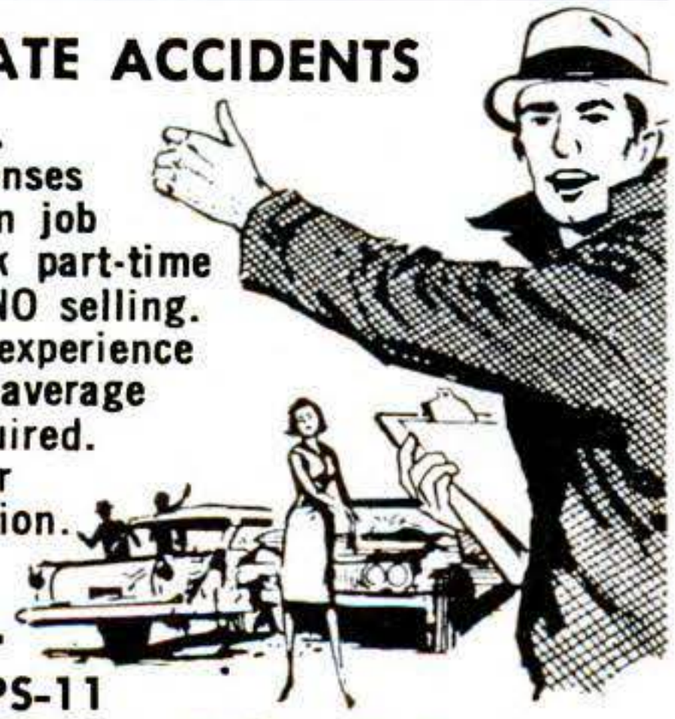

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PS readers talk back continued

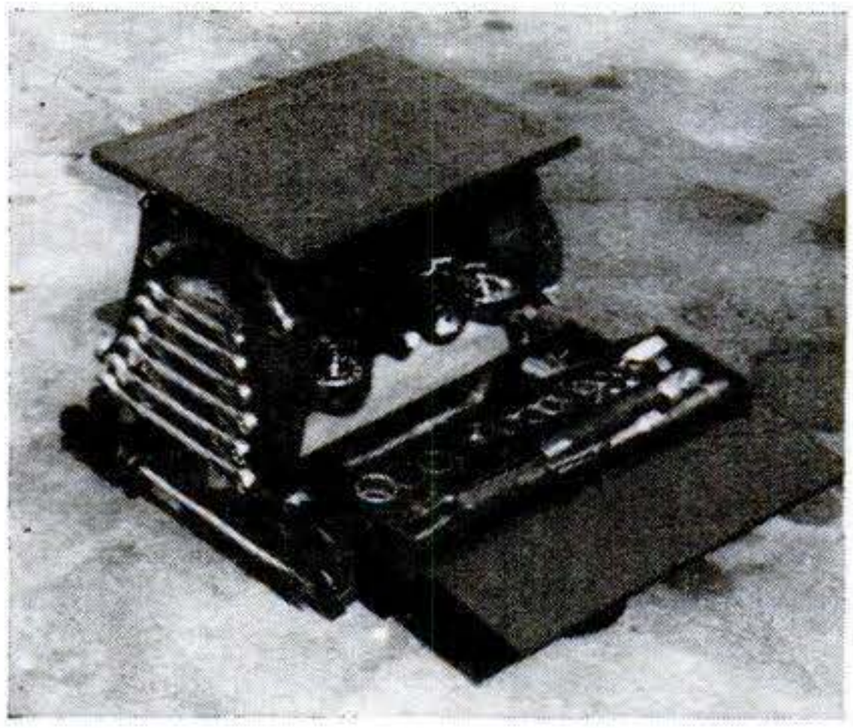
safer. I can't believe that. If manufacturers would put tires on a passenger car that are of the quality of those used at the 500, they'd last for 100,000 miles of ordinary driving. No car or tire company is about to do that.

George Meyer, Orange, Calif.

Styrene-butadiene, now the chief ingredient of standard tires, got its first tests on the race tracks. Soon you'll be getting poly-butadiene, now under test on tracks.

Just What They Needed

The tool-caddie stool that I built from an idea you gave me last May ["Tool Holder Takes You Off Your Feet"] is one of the most valuable items in my garage now. I have everything I need while working on anything! I made a few changes in your plan. I put on



casters, added a tool tray for my socket set, and provided a bit more room for extra tools. I've made lots of things from PS, but this one is the most.

Earl McQueen, Hamilton, Ohio.

. . . The "Yard Cart You can Push or Tow" [July] was just what I needed for my fall yard chores. This little workhorse can carry about anything. It was a fine day-off project. Keep 'em coming.

Bob Hemlen, Bucyrus, Ohio.

Love Finds a Way—or Two

"The Case Against Bucket Seats" [Sept.] is a lot of nonsense. As for chariots of love—I've seen plenty of boys sharing bucket seats with their girls. Anyway, it's a sure way of keeping your mother-in-law out of the front seat! I'll take buckets any time.

J. E. Gadd, Newell, W. Va.

. . . After going on a few dates with our bucket-seated Buick Riviera, I've decided that the best place for it is in the garage while I toot off in our old '58 Merc wagon. I love that Riviera—but I love my girl more.

Ken Roskin, W. Hartford, Conn.

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'64 OLDS

WHERE THE ACTION IS!

Flick the stick... Cutlass does the rest!

Take a hair-trigger transmission . . . tie it to 290 horses and you've got action with a capital "A." That's what Cutlass delivers. Its all-new 330-cubic-inch V-8 power plant sports a four-barrel carb and a 10.25-to-1 compression ratio. Take your choice of a three-on-the-floor, fully synchronized four-on-the-floor, or a silken new variable-vane Jetaway transmission (all optional). But the power-room isn't the only place this bucket-seat beauty has been beefed up. Ten more inches in length, three in wheelbase, two in tread width. Extra inches *inside*. In short, Olds has put plenty into the '64 Cutlass. You'll get plenty out of it!

F-85 CUTLASS

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PS readers talk back continued

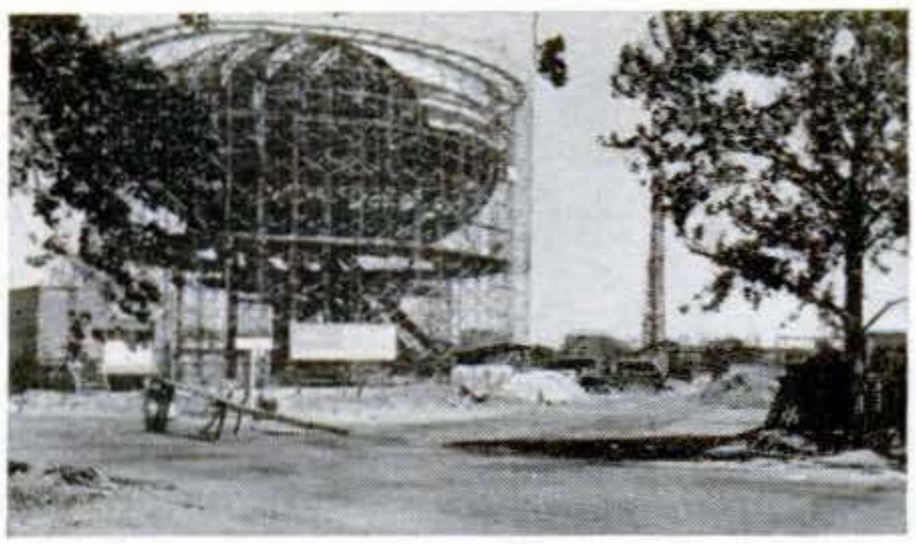
. . . Your frequent references to "bucket seats" on American production cars amuse me. Only the Corvette has even a reasonably vague resemblance to a bucket seat. All the rest are just chairs without legs.

NEIL MANNERUD, New Brighton, Minn.

Old Hand Gives a Hand

Just saw the piece on how parachutists jump hand in hand ["Picture News," Aug., p. 47]. This "buddy system" was developed by our company and, more particularly, James C. Hall, a professional parachutist. It is not Air Force instructors who teach the system. The instructors are civilian employees of our firm; the *students* are Air Force and civilian test pilots. The interest of both groups is indicated by the number of test pilots who have completed the course.

DAVE BURT, V.P.
Parachuting Associates, Inc., Los Angeles.



Did you wonder how PS photographed those '64 cars against New York World's Fair backgrounds in time for the October issue ["The '64 Look"]? Here's the answer: We didn't. Photographer Bill Morris first snapped the Fair buildings. The following week he photographed the '64s—two months before their release date—in Detroit. The transparencies were then combined by color processors so you could see a New York World's Fair building through the rear window of a car in Detroit.

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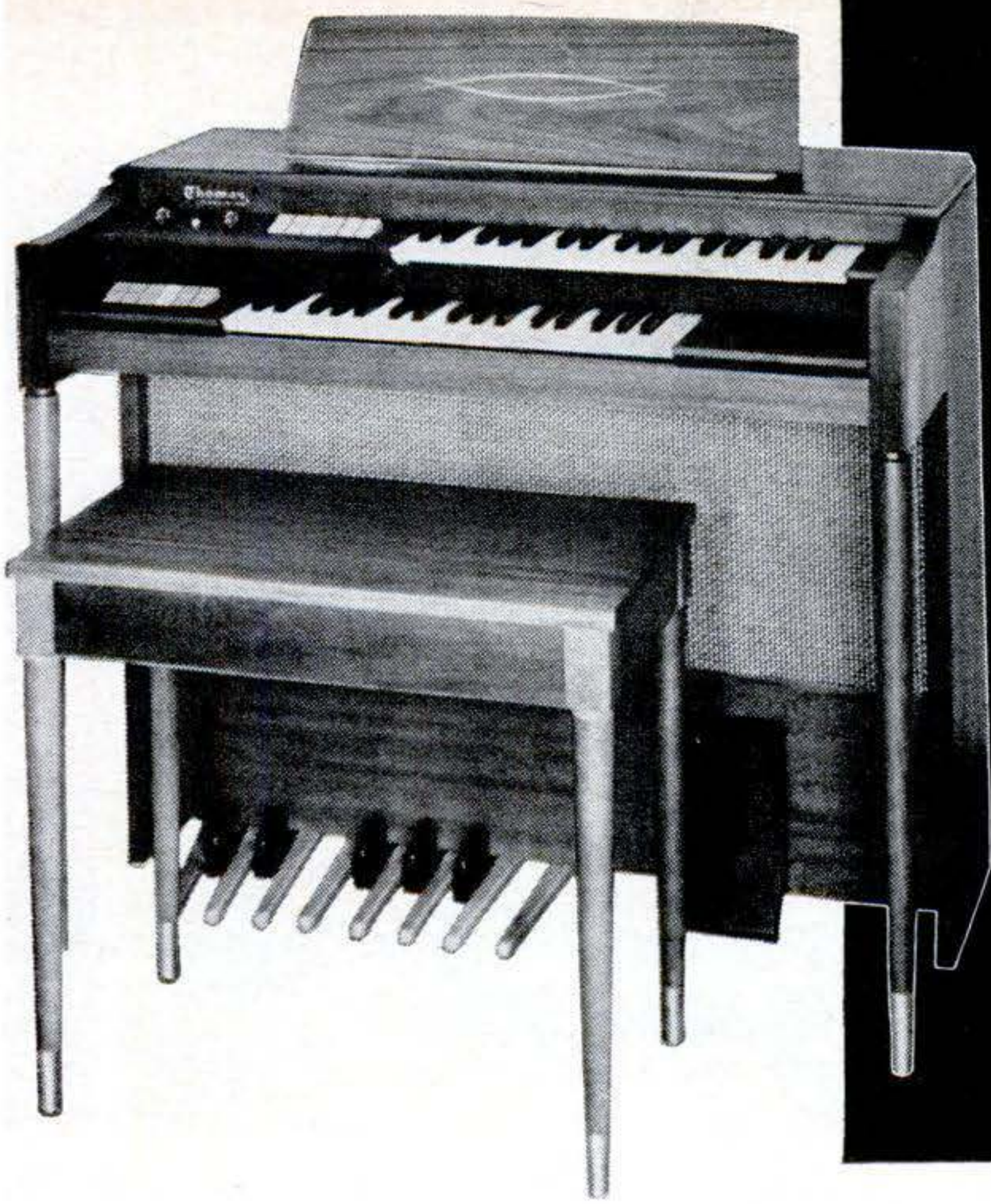

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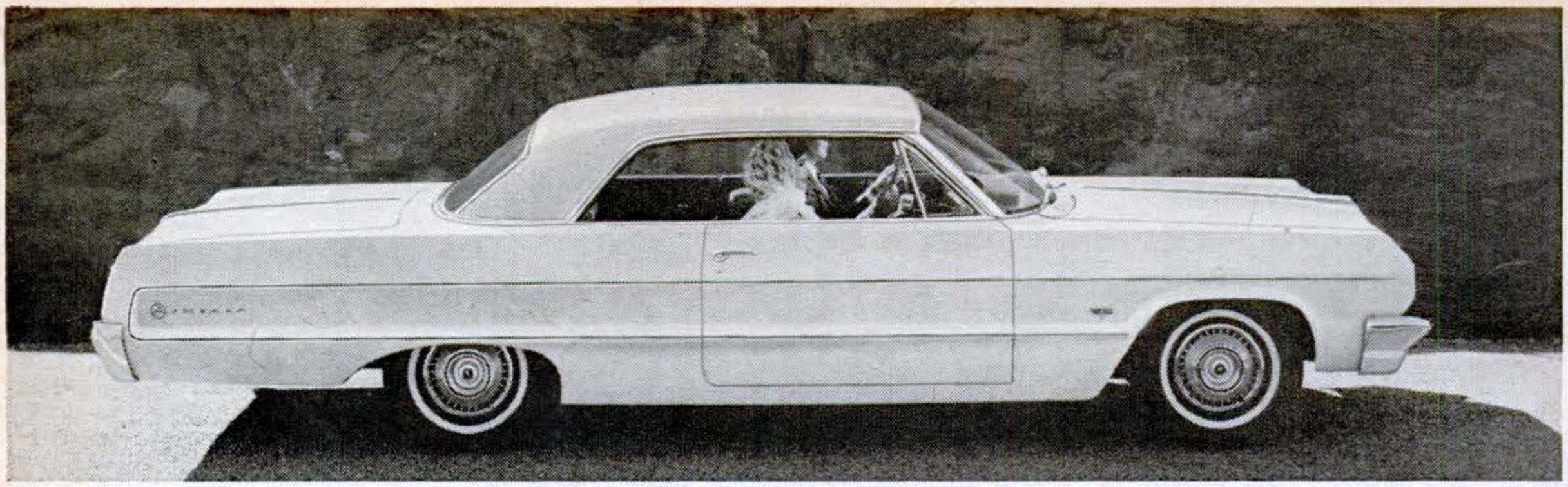
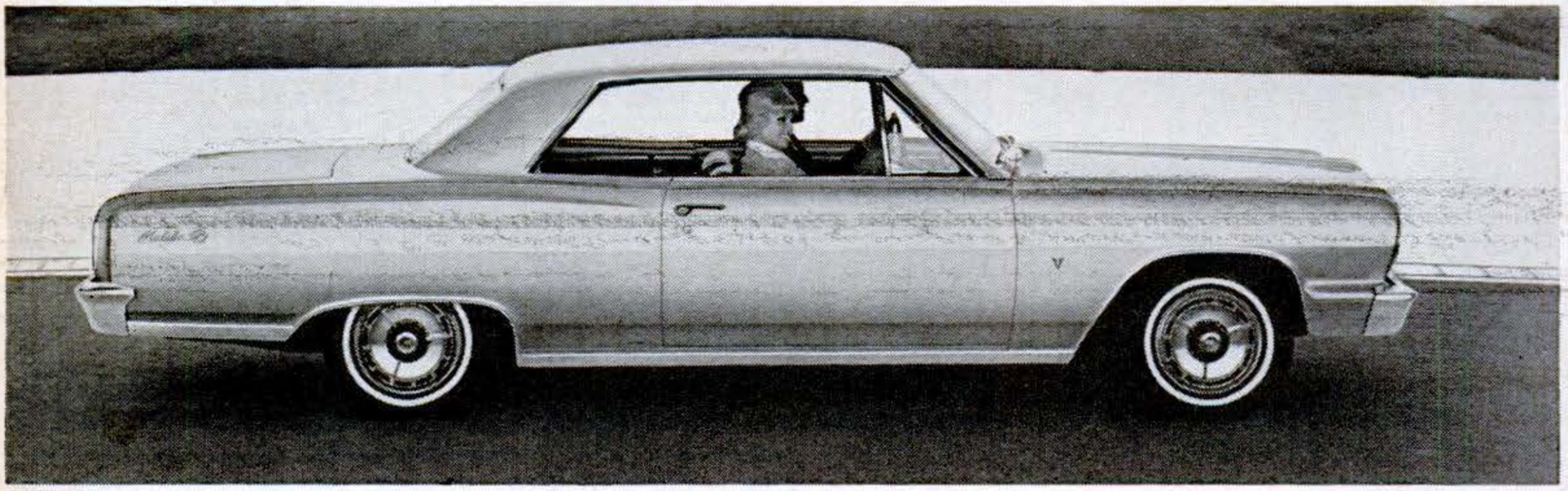
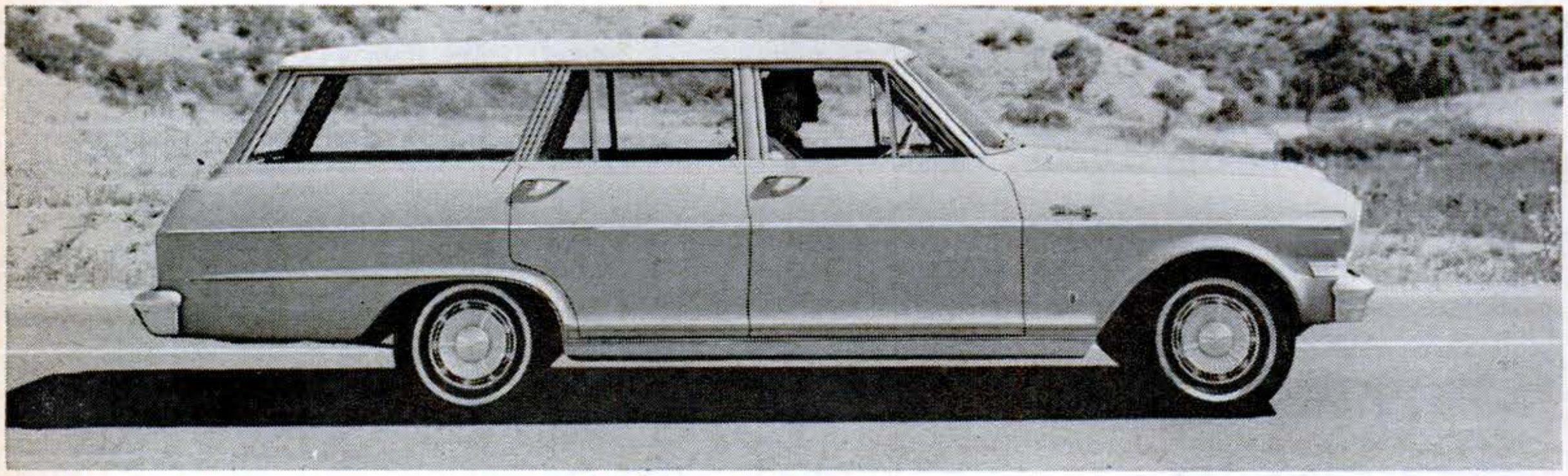


Impala Sport Coupe—one of 15 new models in four series



Chevelle Malibu Super Sport Coupe—one of 11 models in three series



More powerful Corvair Monza Convertible

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Corvette Sting Ray Sport Coupe

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'64 JET-SMOOTH LUXURY CHEVROLET

A CAR THAT'S NEVER BEEN SO LUXURIOUS BEFORE! More luxurious outside with that long clean new look. And much more luxurious inside. The new Impala Super Sport Series, for example, has a new kind of ultra-soft vinyl upholstery and door-to-door deep-twist carpeting that you would be proud to put in your home. And even the lowest priced Biscayne models are now fully carpeted and have arm rests and foam-cushioned seats both front and rear. Then these new Chevrolets have a Jet-smooth luxurious way of going. Quiet. Soft. Transmissions operate smoothly and quietly! That sturdy Body by Fisher and generous coil spring at each wheel cushion you against every kind of road shock. Actually, the whole idea for '64 was to see how much luxury and comfort we could add to the car—but still keep it reasonably priced. And everything worked out just beautifully. Wait until you see it. SEE CHEVROLET'S GREATEST AT YOUR CHEVROLET SHOWROOM.

NEW CHEVELLE ! by CHEVROLET

A KIND OF CAR YOU'VE NEVER SEEN BEFORE! Not a new model or just a new name, but a completely different kind of car from Chevrolet for 1964. Outside, it's a good foot shorter and a few inches narrower than the big cars. Parks in the tightest places. But the passenger space, leg room and trunk capacity are surprisingly generous. Eleven sedans, wagons, coupes and convertibles to choose from. Four engines: a 120-hp Six. A 195-hp V8. An extra-cost 155-hp Six. And an extra-cost 220-hp V8 with four-barrel carburetion. Body is by Fisher —and you know what that means in terms of quality and comfort. Brakes are self-adjusting. Service is seldom. Quality is by Chevrolet clear through. And so is the price, you'll be happy to know. SEE CHEVROLET'S LATEST AT YOUR CHEVROLET SHOWROOM.

THE '64 CHEVY II by CHEVROLET

NEW CHEVY II V8! An optional-at-extra-cost 195-hp V8, to be exact. Chevy II is now the only car made that gives you a choice of Four, Six or V8 power. Two Sixes, by the way. A 120-hp and a new extra-cost 155-hp. And all the new II's are trimmer outside and nicer inside. Each with Body by Fisher, of course. And rust-fighting rocker panels and long-life muffler. And self-adjusting brakes. And all those other Chevrolet engineering features that keep you from dipping into your savings to keep it going. Come dr-r-r-rive a Chevy II V8 at your Chevrolet dealer's showroom.

'64 CORVAIR and '64 CORVETTE

NEW CORVAIR POWER! Nearly 19% more horsepower in the standard engine. A full 110 horsepower in the extra-cost engine. And 150 hp in the Monza Spyder. Some nice new interior refinements, too—like softer, more deeply tufted seats in the Monza and sporty map pockets on the front doors. Outside of that, it's still very much the same easy-to-park, easy-to-handle, hard-to-keep-your-hands-off-of Corvair.

NEW CORVETTE RIDE! Smoother and quieter than it's ever been, but no less of a sports car than it's always been. New extra-cost V8 engines up to 375 hp in both sport coupe and convertible. And note the new *one-piece* rear window in the coupe. You'll be surprised at what a beautiful boulevard car the new Corvette is. Yet it's one of the world's few great sports cars, too. . . . Chevrolet Division of General Motors, Detroit, Michigan.

THERE'S 5 IN 64 CHEVROLET

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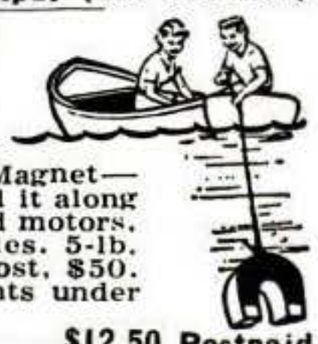

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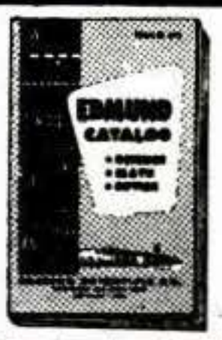

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Science newsfront

BY WALLACE CLOUD

A monthly report: What's going on in science and why it's important to you

GENETICS

Genes without chromosomes

Although geneticists work methodically in peaceful laboratories, they actually live in a world of intellectual rough-and-tumble. Someone's always shaking up their ideas. The latest such shake-up is the announcement, by Dr. Ruth Sager of Columbia University, that her research group has proved the existence of genes that float around in the cell as particles unrelated to the chromosomes.

This discovery joggles the widely accepted idea that hereditary specifications in all living things are conveyed from one generation to the next by means of a code embodied in molecules of DNA (deoxyribonucleic acid). DNA has been identified as the substance of genes, which are arranged in long strings in the chromosomes of the cell [see "DNA: It Calls the Signals for Life," PS, May].

For many years, a few geneticists have suspected the existence of non-chromosome genes, since some hereditary traits don't sort themselves out like chromosomes should. For just that reason, such genes were very difficult to identify by the usual methods of crossing and recrossing experimental animals, plants, and single-celled organisms. Dr. Sager, however, found a way to control the gene patterns in a species of algae, *Chlamydomonas,* fed poisons that some offspring could tolerate but others could not.

It remains to be seen whether non-chromosome genes are made of DNA, and whether they exist in other forms of life, including man.

MEDICINE

Krebiozen unmasked?

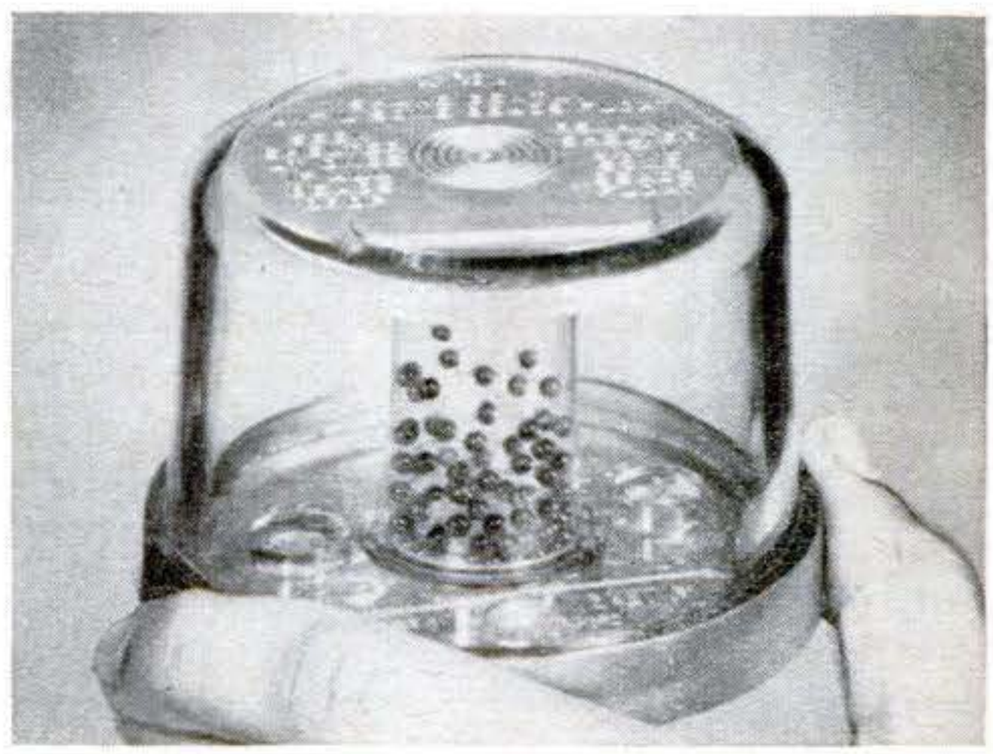
The tangled story of the mystery cancer drug, Krebiozen, is not yet ended. But it has reached a climax with the announcement by the U. S. Food and Drug Administration that the only ingredient in Krebiozen is creatine, a chemical plentiful in meat and a normal constituent of the human body.

For those who tuned in late, the story began in 1947 when Dr. Stevan Durovic, a Yugoslav refugee, first prepared the drug in Argentina by injecting horses with a tumor-producing fungus, then extracting from the horses' blood serum a substance supposedly produced in reaction to the injection. In 1949 Durovic interested Dr. Andrew C. Ivy, a distinguished physiologist and a vice-president of the University of Illinois, in his discovery. Krebiozen, incidentally, is coined from the Greek, meaning "that which regulates growth."

Ivy's endorsement of the drug in 1951, after he had tested it on 22 cancer patients, started a storm of controversy. Ivy lost his job at the university and Dr. George D. Stoddard, president of the university, who

CONTINUED

This simple-minded gadget could save your life in the event of a nuclear war or reactor explosion. It's a radiation detector, and it can tell you if there's dangerous fallout in the neighborhood. Shaking the instrument gently creates static electricity that holds red beads in suspension; but in the presence of ionizing radiation the static electricity is neutralized, and the beads fall to the bottom of the tube. You can even tell roughly how much radiation by how long it takes the beads to fall. The detector is on the market for $5.00, available from Nu-Klear Sales, Dept. PS, P.O. Box 765, Westport, Conn.



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had attacked Ivy, was also forced to resign. Ivy has remained a staunch defender of Krebiozen.

Durovic has never provided a clear explanation of the chemical nature of Krebiozen, protesting—logically enough—that other drugs have been used successfully before their composition was known. More to the point is the question of Krebiozen's effectiveness against cancer. This question has never been satisfactorily answered, although not for lack of investigation. The air has been thick with reports and counter-reports, but the studies have always been marred by Durovic's reluctance to cooperate or the investigators' haste to find Krebiozen worthless.

Meanwhile, thousands of cancer victims have been treated with the drug, which Durovic's firm, Promak Laboratories, has supplied to doctors on an experimental basis. Naturally, the patients who feel that Krebiozen has helped them, and their relatives, have developed a strong emotional bias in favor of the drug. This was displayed when Krebiozen supporters picketed the White House in June, just before the deadline for filing an application for experimental status under the new drug law (enacted in the aftermath of the birth abroad of thousands of deformed thalidomide babies).

Vacuum aids birth. Instead of using forceps to yank reluctant babies into the world, doctors are now trying a suction device invented in Sweden. Shaped like a plumber's helper but made of stainless steel, the vacuum extractor holds the baby's scalp firmly and safely, reduces injuries to mothers that are sometimes caused by forceps.

Krebiozen's promoters did reluctantly file a good deal of data with the FDA. They also provided samples of the drug, a yellowish-white powder, for analysis and testing. In addition, the FDA had an infrared spectrogram (a kind of chemical fingerprint) of Krebiozen, which Durovic had given the National Cancer Institute in 1961.

FDA specialists set out to see if they could identify the chemical portrayed by the spectrogram, even before analyzing the new samples of Krebiozen. This involved searching through a gallery of infrared curves

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of 20,000 different organic chemicals. After the similarity between the curve of creatine and that of Krebiozen was spotted, the investigators analyzed the new samples by the infrared technique and also by three other methods—microscopic crytallography, X-ray diffraction, and mass spectrography.

All these tests showed Krebiozen to be identical with creatine, a chemical known to have no effect on cancer. The human body, normal or cancerous, contains about 120 grams of creatine, compared with the 1/100,000 of a gram that is dissolved in mineral oil in an ampule of Krebiozen.

Drs. Ivy and Durovic have now denied that Krebiozen is creatine, insisting that the only way to evaluate the drug is through clinical tests on cancer patients. Case histories of 508 patients who have allegedly been helped by Krebiozen are still being studied by federal officials.

If it should turn out that Krebiozen is indeed nothing but creatine, that will explain why some testing labs in the past have been able to find nothing but mineral oil in ampules of Krebiozen—the solubility of creatine in mineral oil is extremely low.

Salt-free diet best for trees. Sugar maples that line the roads and drainage systems of New England are being killed slowly by the salt used to melt ice on the roads in winter, according to botanists at agricultural-research stations in New Hampshire and Connecticut. They're trying to find a way to neutralize the salt and save the trees. A symptom of the ailment is that the maple leaves turn red about a month too early in the autumn. Maple syrup from the injured trees is apparently unaffected, the researchers say.

SPACE

The $10 million washer

Latest space goof to be revealed is that a two-cent fiber washer was probably responsible for the failure of the $10 million Ranger V moon probe in October, 1962. This appears to be in a class with the hyphen inserted improperly in a computer program that fouled up the first Mariner probe to Venus.

Ranger V, like the four previous Ranger failures, was an attempt to crash-land instruments on the moon and take TV close-ups on the way down. The cause of failure was evidently a washer insulating a stud from the chassis in the spacecraft's switching circuits. With age, the washer yielded and the stud loosened, spoiling connections.

The Ranger program has been overhauled thoroughly and Ranger VI is scheduled for launch late this year. A phenolic-impregnated fiberglass washer will be used instead of the fiber one.

Off-the-shelf rockets

The U. S. should sell space boosters to other nations, says Rep. Joseph E. Karth, chairman of the House Space Sciences Subcommittee.

He advocates selling the Atlas and eventually Saturn and Centaur rockets to foreign governments and industrial combines for peaceful uses—such as orbiting communication satellites and for space experiments. The money would go to American space industries, not the U. S. government. Overseas buyers would have their rockets launched from our pads, since building launch facilities is too expensive for most governments. Launch operations would be handled by American technicians to keep our space-technology secrets safe.

That there's a market for big boosters is indicated by the gradual emergence of a European space industry: Britain is building the Blue Streak rocket for the multination European Launcher Development Organization, and France is building its own Diamant booster. The U.S. has made available Scout and Thor boosters free to England, Canada, France, and Italy for orbiting scientific payloads.

Several companies in this country now make small meteorological rockets that are available as standard products to qualified buyers—universities and other research organizations. ■■

X-15 peak. For the record: Joe Walker, NASA's chief test pilot, flew the X-15 research airplane to a new altitude mark of 354,200 feet (67 miles) on August 22. Top speed during the 10-minute flight was only 3,614 m.p.h. Walker also holds the X-15 speed record, 4,104 m.p.h., set on June 27, 1962.

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Commercial
Professional Secretary
Shorthand
Stenographic
Typewriting

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Welding Processes

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Carding and Spinning
Cotton Manufacturing
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Loom Fixing
Spinning
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Getting Ahead

By Dr. Lewis R. Fibel

A monthly column to help you prepare yourself for a better job

Making up your mind on a career? A helpful booklet is put out by the Department of Labor: *Choosing Your Career* (15 cents, Supt. of Documents, U.S. Government Printing Office, Washington, D.C. 20402). Included are check lists of interests and aptitudes, and a self-inventory analysis to aid you.

Leaping technology. By 1970 there will be over four million scientists, engineers, technicians, and teachers in the country—in number, 50 percent more than today. The percentage of technical manpower in the labor force will have jumped from 1½ percent in 1940 to close to 5 percent.

	1940	1950	1960	1963	1970
	thousands employed				
Scientists	145	245	435	500	750
Engineers	300	545	840	935	1400
Technicians	300	550	875	1000	1600
Teachers of science and mathematics in secondary schools	110	130	220	250	300
Total	855	1470	2370	2685	4050
Percent of U.S. Labor Force	1.5%	2.2%	3.2%	3.6%	4.7%

Source: National Science Foundation

"I graduated as a civil engineer in 1951. I'm worried now about the problem we engineers over 40 face as we compete for jobs or advancement with younger men whose training is more up-to-date."—M. E. MacD., St. John, Can.

The problem you pose is very real. One general answer is that each individual has an obligation to himself to continue his education all his life. This should not be just in his occupation, but also generally, for personal growth.

The technical societies offer one good method of keeping abreast professionally. Local chapters of the American Society of Civil Engineers, for example, have programs with speakers on new developments. Their journals and bulletins are further supplements. You should read these, as well as other technical and popular magazines and books. Set up a reading program for yourself, with a set schedule that you will keep as regularly as a Wednesday-night bowling date.

My final suggestion is that you take an occasional course, either by correspondence or in residence, to keep you up to date.

"I have a job as an assistant X-ray technician in a hospital. I'd like to know what colleges grant degrees in radiology."—D. L., Clarksburg, W. Va.

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Alderson-Broaddus College, Philippi, West Va.

St. Louis University, St. Louis.

"Where can I get information on a career as a funeral director (embalmer)?"—D.R.N., Calhoun City, Miss.

You might read *Funeral Services as a Career* by Wilfred E. Belleau (75 cents, Park Publishing House, 4141 W. Vliet St., Milwaukee 8) and *Funeral Services as a Profession* (15 cents, National Funeral Direc-

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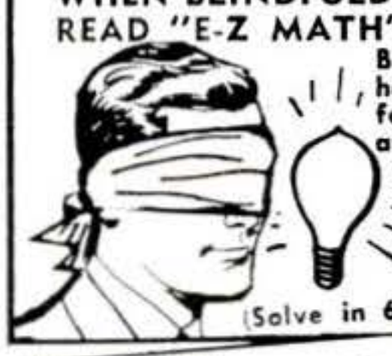

Blindfold yourself and have someone call the following numbers to you as you add them:

739
463
906
785
642
?

(Solve in 6 seconds)

$\frac{9864372}{8146}$ = ? (Solve in 9 seconds)

$\frac{4}{7} \times \frac{9}{4}$ = ? (Solve in 4 seconds)

1¾% interest per month amounts to what percentage yearly? (Solve in 4 seconds)

367 X 75 = ? (Solve in 3 seconds)

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tors Assn., 135 W. Wells St., Milwaukee 3).

There are a great many schools that offer courses. Among them:

California College of Mortuary Science, 1920 Marengo St., Los Angeles.

Worsham College of Mortuary Science, 1901 W. Wolcott St., Chicago.

Indiana College of Mortuary Science, 1201 N. Capitol St., Indianapolis.

Cincinnati College of Embalming, Reading Rd. at Whittier, Cincinnati.

"How can I become a chemical engineer?"—J.P., Andreas, Pa.

The usual route is to graduate from a four- or five-year course of study leading to a bachelor's degree in the field. The Engineers' Council for Professional Development has accredited chemical-engineering curriculums in about 100 colleges and universities in the country.

These pamphlets will tell you more:

Chemical Engineers (45 cents, Science Research Associates, 57 W. Grand Ave., Chicago 10).

Opportunities in Chemical Engineering, by Raphael Katzen ($1, Vocational Guidance Manuals, Inc., 1011 E. Tremont Ave., NYC. 60).

"Where can I study gemology or jewelry design?"—R.K., Santuce, P.R.

Here are several possibilities:

Gem Lapidary and Washington School of Gemology, 2006 Florida Ave, N.W., Washington, D.C.

John M. Wise School of Gemology, 108 W. Fayette St., Baltimore, Md.

Gemological Institute, 5 E. 47 St., NYC.

Mechanics Institute, 20 W. 44 St., NYC.

"It is impractical and financially difficult for me to attend law school full time. If I got a law degree by correspondence would I be able to take the bar exam in various states?" —L.C.W., Richmond, Va.

To qualify for the bar exams in most states, an applicant must be a graduate of a law school approved by the American Bar Association or by the proper state authority. A few states permit graduates of correspondence law schools to take the exams, and some will accept study in a

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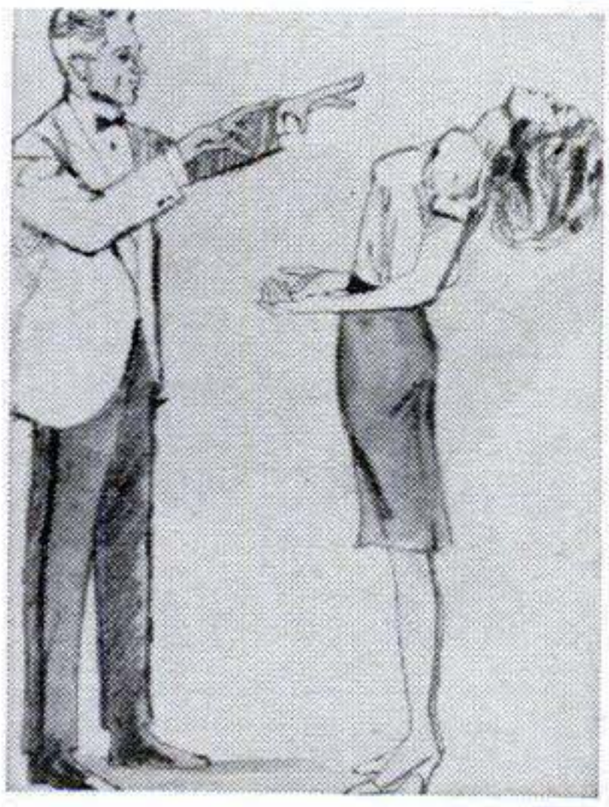

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HOW TO GAIN MAGNETIC NEW PERSONALITY

MESMERISM
Quick technique for hypnotizing.

MAGNETIC HEALING
How to stop pain. Much surgery is performed by Hypnotism.

HOW TO HYPNOTIZE FOR MONEY

CURING BAD HABITS
End sleeplessness, stop smoking, lose weight, etc.

POWER OF SUGGESTION

HYPNOTIZE YOURSELF

MAGNETIC INFLUENCE

HYPNOTIZING CROWDS

HOW TO ENTERTAIN

HYPNOTISM IN BUSINESS
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285 Market St., Newark, N. J.

SIMPLE SECRETS REVEALED AT LAST

For years the knowledge of how to produce hypnotic sleep has been so well guarded that only a few have mastered this art. But now the veil of secrecy has been lifted and the innermost SECRETS and techniques revealed for the first time. The fact is that Hypnotism is a scientific fact that anyone can learn. Once you know these secrets and methods you can bring about this strange and wonderful control that has only been used by doctors, psychiatrists and entertainers in the past. Yes, now this remarkable phenomena will be yours to use for pleasure, self-development and countless other benefits.

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First, you must understand that what another person does with Hypnotism, you can also do. There isn't anything anyone has ever done with this art that you cannot do! YOU can make people cry, laugh, shout, stop smoking, recall childhood memories, act like an infant, make water taste like vinegar, get folks to sing, dance ...do a 1001 things they would never do when not UNDER YOUR POWER. And the most amazing thing of all is --- HOW EASY IT IS TO DO!

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Here at last! In three short, simple chapters you learn the hidden secrets of Hypnotism and how to work this scientific miracle. No long, technical, mumbo-jumbo explanations are given. The entire 25-lesson Guide to Hypnotism is written in plain, SIMPLE language that anyone can understand. After the third lesson you are able to begin performing countless techniques and powers clearly explained in the next 22 lessons. You'll learn how to cure bad habits in yourself and others, how to BUILD PERSONAL MAGNETISM, SLEEP without drugs, use Hypnotism to help STOP PAIN, BUILD WILL POWER, HELP LOSE WEIGHT, IMPROVE YOUR MEMORY and so much more. And you'll learn how to MAKE MONEY with your new power by entertaining at parties, lodges, club meetings, etc. Truly, this knowledge will give you a New SURGE of CONFIDENCE and POWER unlike any you have ever known!

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Never before has such a Complete and authentic course on Hypnotism been available at such a low price. Doctors and students have PAID hundreds of DOLLARS for personal instruction in Hypnotism, when obtainable. Knowledge such as this can be worth THOUSANDS of DOLLARS to the user over the years. Yet, due to printing economies, large press runs and also by the elimination of correspondence costs, the complete 25-Lesson Guide To HYPNOTISM is yours for only $1.98. Yes, only $1.98 for the COMPLETE COURSE bound in book form. Certainly a tiny investment for so much!

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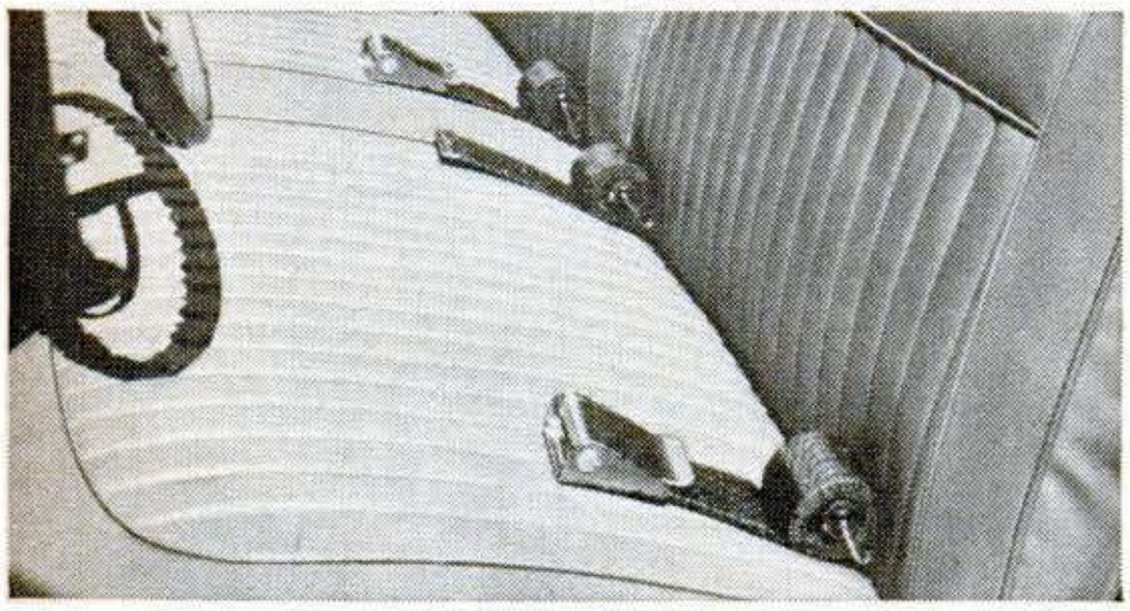

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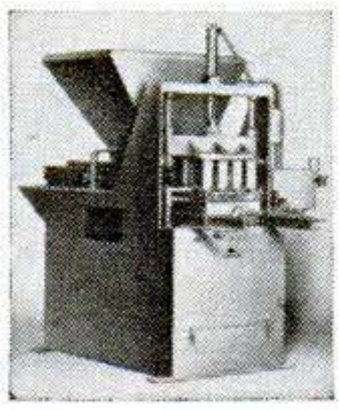

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Getting Ahead continued

law office instead of, or in combination with, study in a law school. Write to the Secretary of the State Board of Legal Examiners for specific regulations.

You might also consider whether you want to practice law or to use your legal background to assist you in business. As an aid, you might find that correspondence study would exactly fill the bill.

"I'd like to learn how to repair speedometers. What schools offer courses?"—R.O.W., Sabillasville, Md.

A number of readers have asked about specialized areas of automotive work. The following accredited home-study institutions do offer a variety of auto-mechanical courses. Probably they include some material on speedometer repair:

American School, Drexel at 58 St., Chicago 36.

American Technical Society, 850 E. 58 St., Chicago 37.

Commercial Trades Institute, 1400 W. Greenleaf, Chicago 26.

International Correspondence Schools, Scranton 15, Pa.

LaSalle Extension University, 417 S. Dearborn, Chicago.

National Technical Schools, 4000 S. Figueroa, Los Angeles 37.

"What kind of jobs are there for a person with a degree in history and a minor in political science, or the opposite?"—T.H. Elkin, N.C.

About 80 percent of historians teach in college; most of the rest work in government agencies or nonprofit organizations. These figures don't include high-school history teachers who generally have less formal education. The total number of historians is about 10,000. Employment is expected to increase substantially in the next decade. The situation is almost identical for a political scientist.

• •

Send your questions on careers and technical training to:

Getting Ahead Editor, POPULAR SCIENCE
355 Lexington Ave., NYC 10017

Not every question may be used. Questions cannot be answered by individual letters.

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Personal-use report:

Electric Typewriter Has Battery, Will Travel

Power plant is revealed as PS Senior Editor Joan Steen lifts Poweriter. Shiny cylinder near power pack is DC motor.

IT HISSES softly. It leaps at a gentle touch. It's smooth and sleek. What makes it special, however, is that it can go anywhere. It's a portable electric typewriter —battery powered.

You can type cordlessly for up to 10 hours, and then recharge the cell via the nearest 110-volt AC outlet. Or if you're nowhere near AC (you're a foreign correspondent in the desert, maybe), you can carry extra power packs with you.

The dual-power $199.50 machine, on the market since April, is the Poweriter, the newest design of Smith-Corona. A nickel-cadmium battery powers a 5.2-volt, permanent-magnet DC motor that drives the keys. A silicon-diode rectifier recharges the battery whenever the Poweriter is plugged in—no matter whether the operating switch is on or off. Leaving the machine plugged in overnight will fully recharge the cell, with no danger of overcharging. It's said to be rechargeable a minimum of 400 times.

Things I liked about the Poweriter in the course of two weeks' testing are its sensitive touch control (I like a light touch), its clean white keyboard, the line retainer (a godsend when you're typing footnotes or subscripts), and the repeat keys: the dot, dash, underscore, x, and spacer. The casing itself is handsome, and comes in light gray, charcoal, or green.

Things you might not like: lack of full automation (margin setting and carriage return are manual); the weight (26 pounds *is* portable, but how far?); proximity of the shift lock to the "a" (although fast, I'm not a professional typist; more educated fingers might avoid this pitfall); and the machine's whispering hiss. I grew used to that hiss. It seemed to give my work an inspired sense of urgency.—*Joan Steen.*

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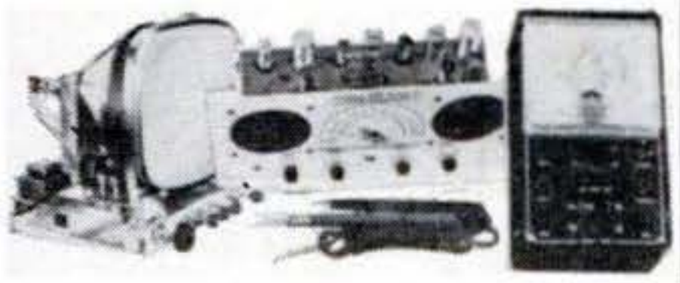

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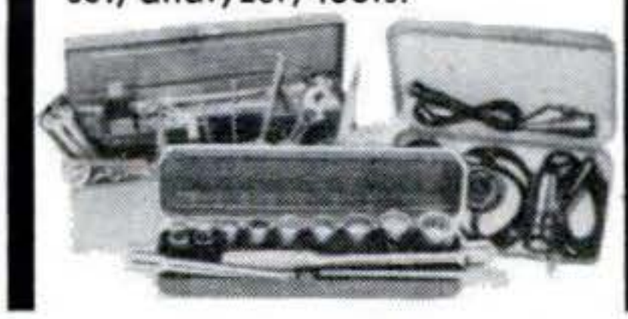

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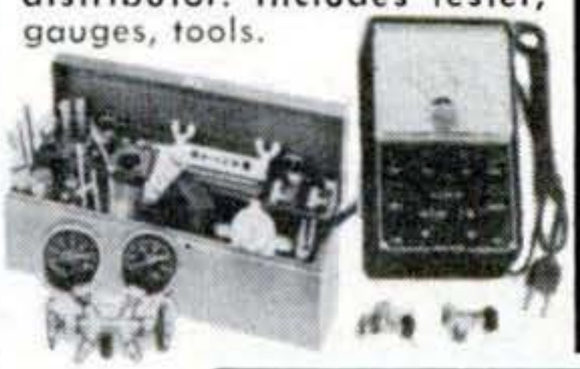

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Here it is! The revolutionary new Live-Longer, Look-Younger, Feel-Better Medical Program that you've been hearing rumors about for years! Whose main principles have already been featured in twenty-seven major American newspapers . . . broadcast to the country by NBC Monitor news and the United Press . . . released to the medical profession by articles in medical journal after medical journal throughout the United States!

Now brought to you, in complete detail, in one of the most thrilling books you have ever read! A fascinating, down-to-earth, easy-to-read book that shows you — in the first ten minutes you pick it up how to:

(1) Add up to forty healthpacked years to your life! Years filled with strength, vigor and vitality! *And have the time of your life doing it!*

2) Ward off the diseases of middle and old age that cripple your friends — and do it in just a few fun-packed minutes each day!

3) Look slimmer, younger, far more attractive OVERNIGHT! Perform a miracle in your figure in just six seconds a day! Develop maximum strength in whatever part of your body you wish in just six seconds a day! Beat daily tensions — drain away that "always tired" feeling — eat better, work better, play better and sleep better, starting this very same week!

In other words, pump up to twenty years of new youth back into your body — whether you're thirty, fifty or seventy years old today!

WHY LET YOUTH SLIP, THROUGH YOUR FINGERS, WHEN YOU CAN GAIN IT BACK IN JUST A FEW SHORT MINUTES A DAY!

Yes! For years medical science has asked itself one maddening question — **Why do people age before their time?**

Why do men lose their vigor and vitality — develop jowls and a paunch — begin to huff and puff when they climb stairs — give way to fatigue, sickness and pain that shouldn't be there for another twenty to thirty to forty years at the least!

Why do women turn almost overnight from slim young brides to fat heavy matrons — with all the glow gone from their complexions — with their sexual attractiveness evaporated — with their entire lives one long series of battles against aches, exhaustion and sly creeping diseases that make them old, overnight!

Can something be done to prevent this premature aging? Can these symbols of old age be pushed off for ten, twenty, even forty years? Can youthful vitality, youthful appearance be restored? CAN YOUR PHYSICAL AGE—WITH THE PROPER TRAINING — ACTUALLY BE UP TO FORTY YEARS BELOW YOUR CALENDAR AGE?

The answer to all these questions is Yes! Medical science has now discovered that there are whole nations of men and women who live to be a happy and healthy **one hundred and twenty five years old!** Who do hard productive physical work to the age of one hundred and ten! Whose men actually father children right up past the age of ninety!

Medical science has proved in Europe that a simple self-preservation routine — in test after test — has cut the amount of bed-ridden illnesses among participants to a mere 15%! Medical science has proven in Ohio that this same simple routine has increased the life expectancy of overweight men by as much as **twenty full years — even though these men suffered from blood pressure so high it was as dangerous as poison!**

Yes! Medical Science has proved — all over the Free World — that the man or woman who follows this simple program of self-protection MAY ACTUALLY BE IN BETTER CONDITION AT EIGHTY OR NINETY THAN OTHER MEN ARE AT THIRTY OR FORTY!

How can this be done? What is this simple self-preservation routine? As now released to you in Dr. Martin's revolutionary new book, it consists of two thrilling parts — **both of which will cut years off your appearance, at the same time that they add years to your life!**

THE FIRST STEP — EXERCISES WITHOUT MOTION, THAT TAKE ONLY 6 SECONDS EACH!

First, to give you overnight results from this amazing Live-Longer, Look-Younger Program, Dr. Martin introduces you to the incredible SIX SECOND ISOMETRIC EXERCISES — that were recommended by the Illinois State Medical Association . . . that are so fabulously effective that they were actually kept "top secret" when they were used in closed-door training by the United States men and women's Olympic teams!

Think of it! Here are simple, easy-to-do exercises that you perform only three times a week, and only six seconds each time! A total of only **eighteen seconds per week** for each exercise — with no motion and no sweat — simply pitting one muscle against another as shown in the illustrations on this page! **And here's what they do for you —**

If you are a man, these six-second exercises will straighten your, broaden your shoulders and — above all — **pull in your stomach,** sometimes as much as two to three inches in the first few weeks! They'll put new drive in your legs, new wind in your chest, new power in your grip!

Or, if you are a woman, these six-second exercises will firm you up where you need it most — in your hips and thighs, in that bulging tummy, under your chin and around the neck, even in that sagging upper arm! They'll put new grace in your step — give you a posture and a figure and a walk that can stop men in their tracks a full block behind you!

LOOK SLIMMER INSTANTLY!

Would you invest six seconds a day — three times a week — to take inches off the appearance of your waist!

This man is doing a simple six second exercise, which will straighten his back — pull in his stomach like nothing he has ever done before! The full details of this exercise are given to you in Dr. Clement Martin's revolutionary new book — HOW TO LIVE TO BE 100. Read it for ten full days without risking a penny! Send in the No-Risk Coupon — TODAY!

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BE A HUNDRED!

Clement G. Martin, M.D.

Member of the Illinois State Medical Association, former Medical Director for the Continental Casualty Company and consultant to President Kennedy's Committee on Physical Fitness. Author of the revolutionary new book. **How to Live to be 100**, with a foreword by Dr. Edward R. Annis, President of the American Medical Association.

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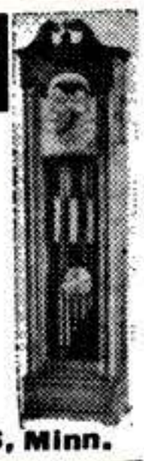

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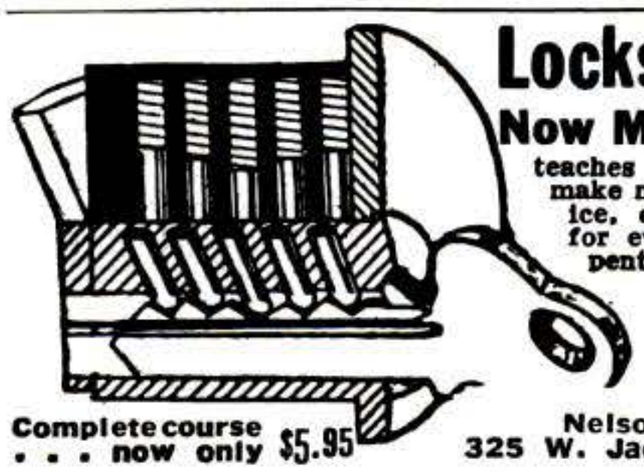

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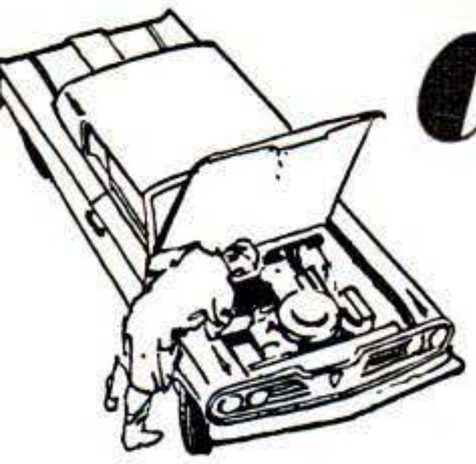

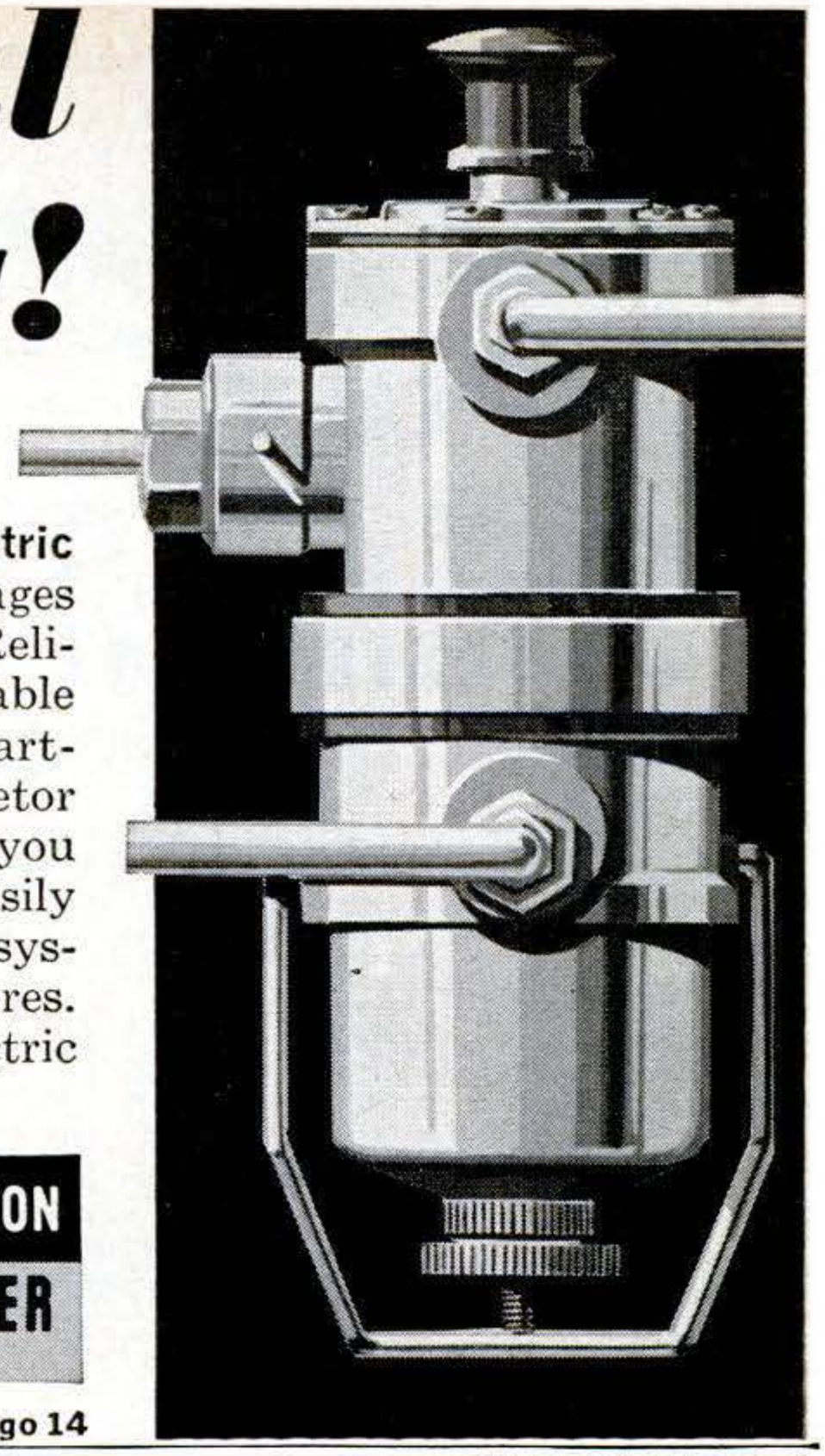

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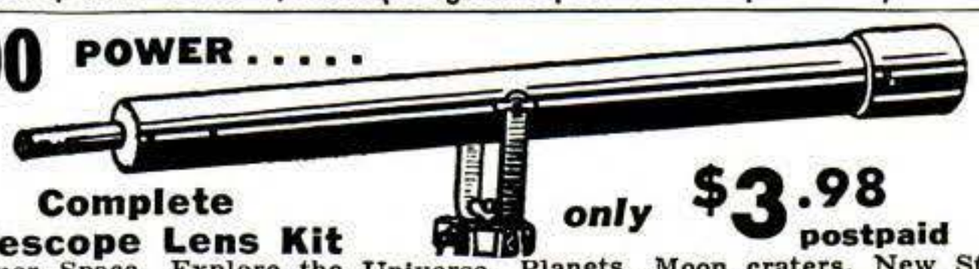

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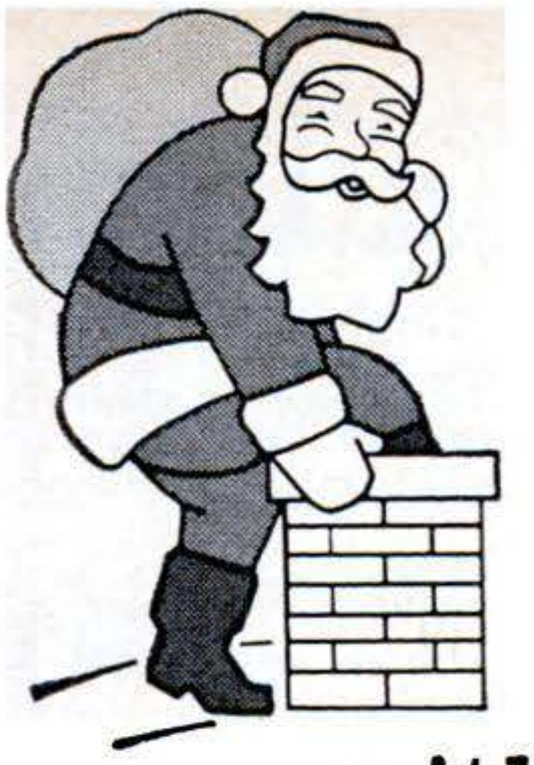

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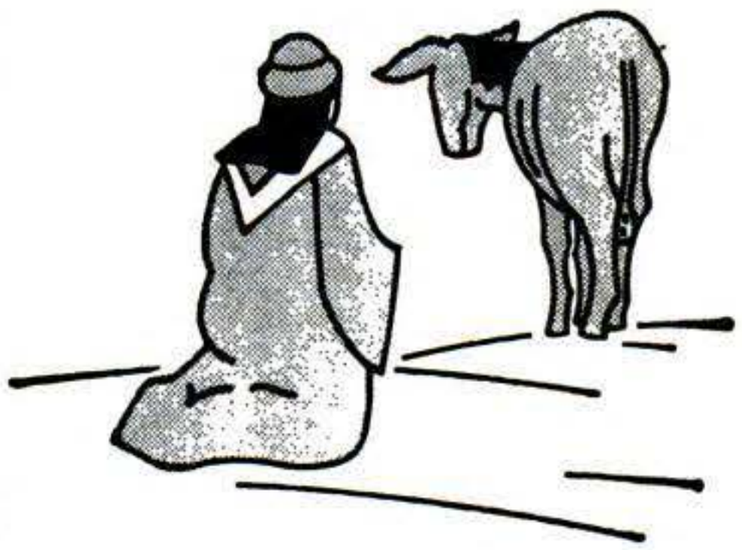

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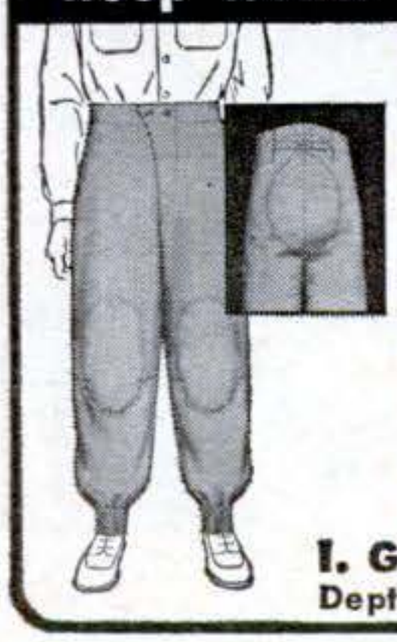

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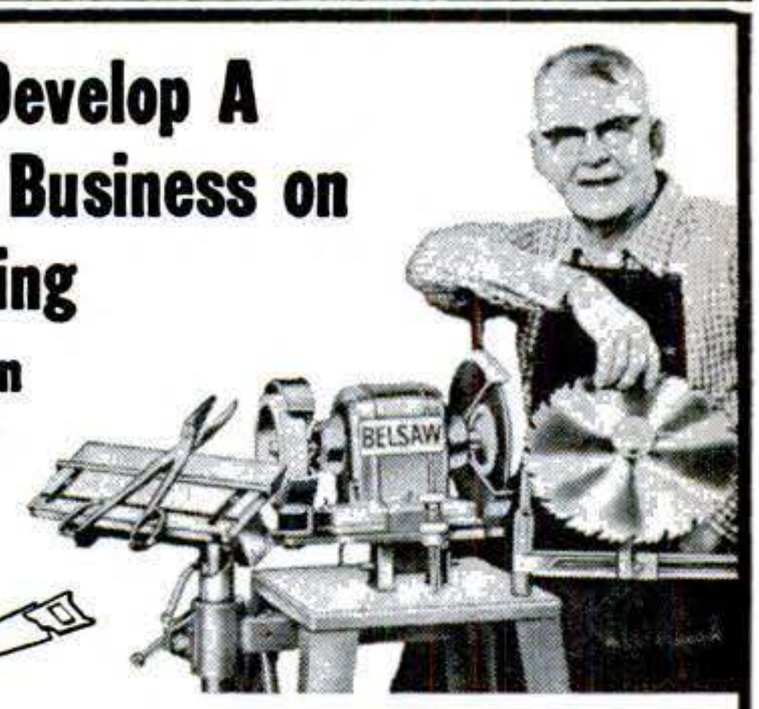

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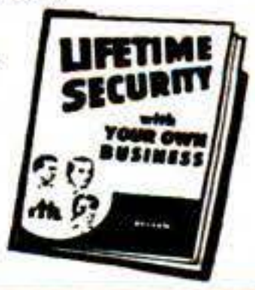

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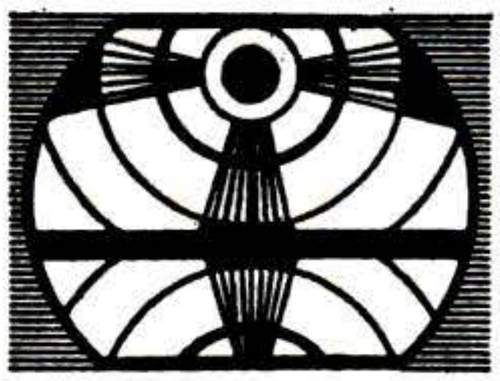

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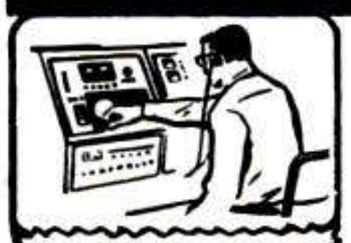

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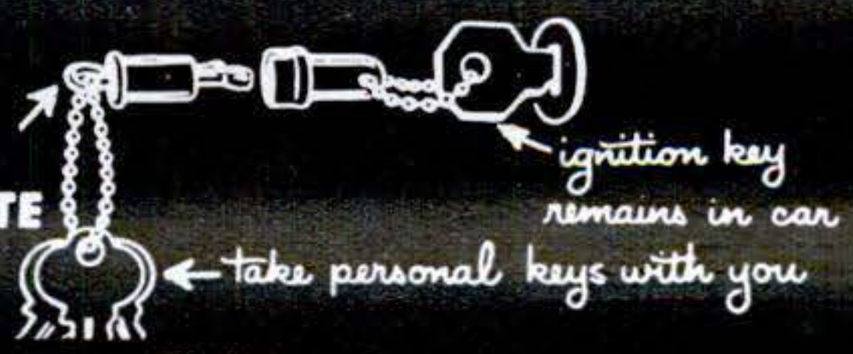

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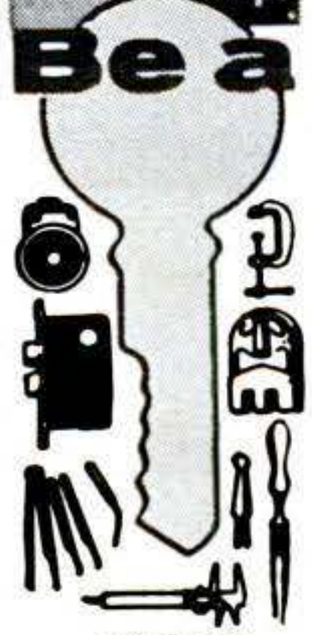

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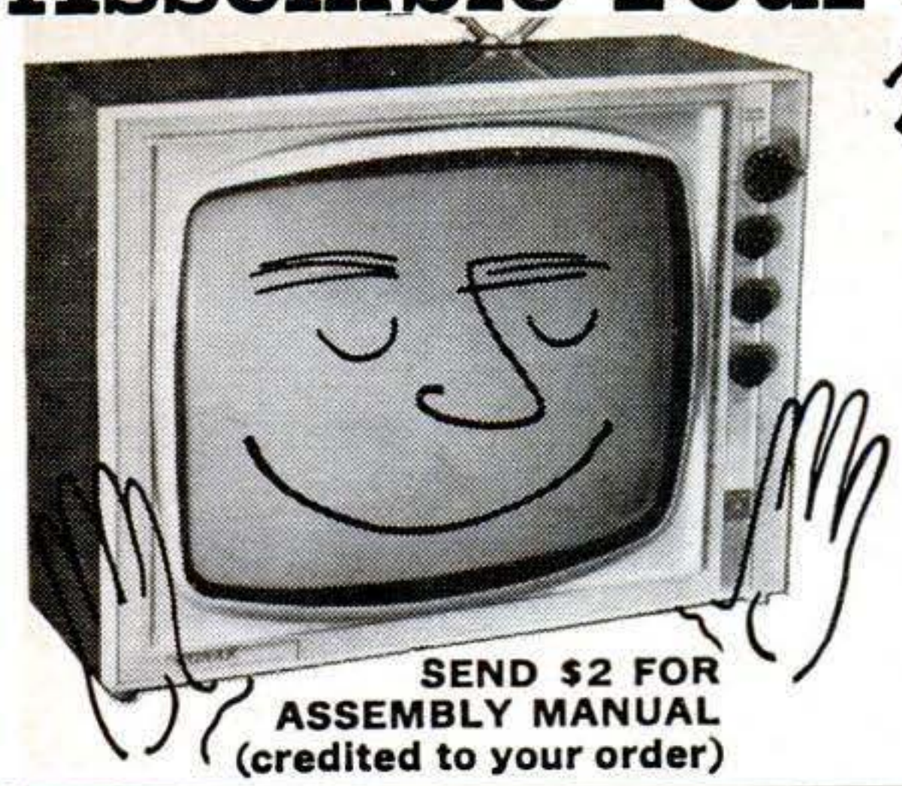

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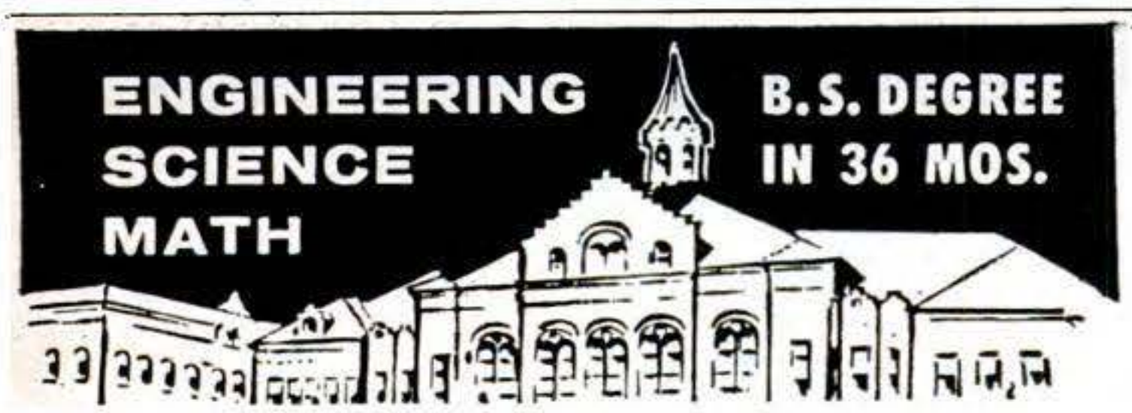

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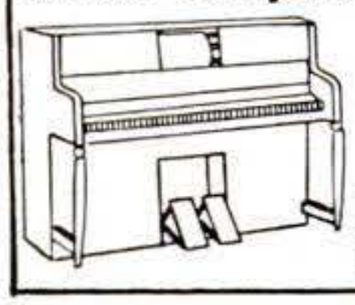

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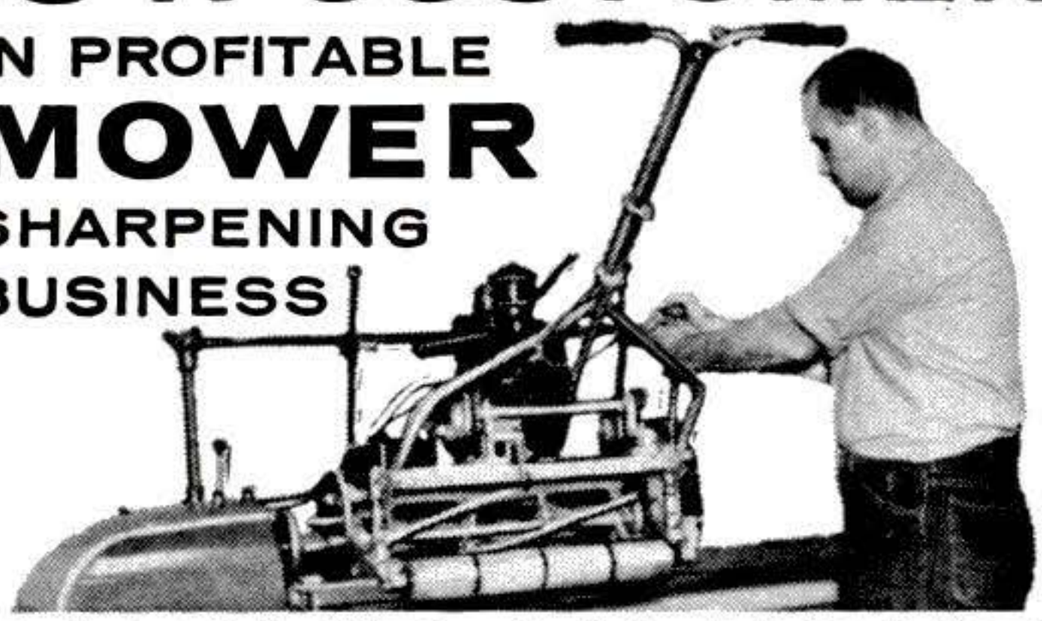

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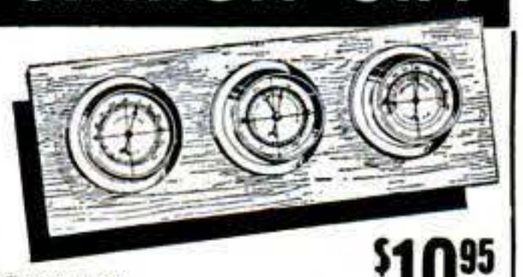

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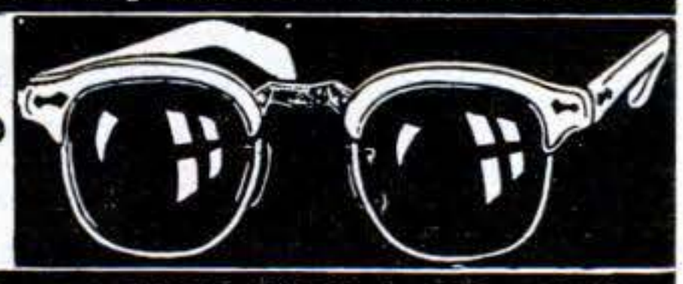

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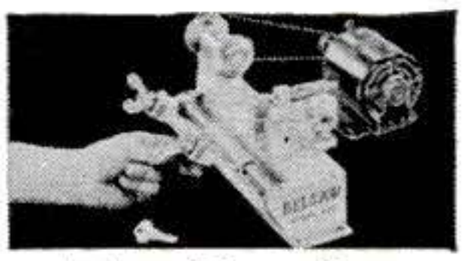

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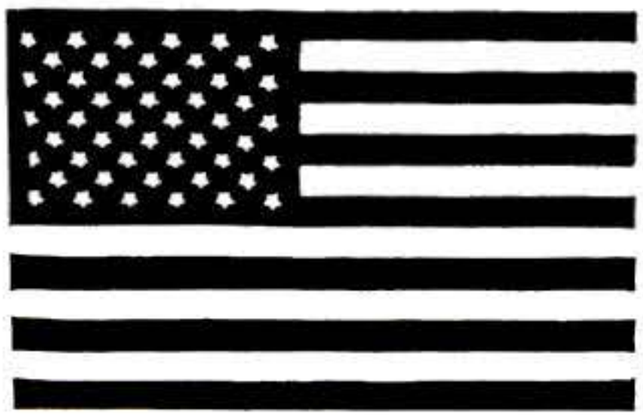

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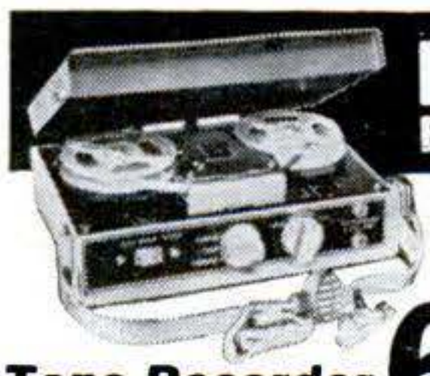

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Detroit report

By Devon Francis

Coming for 1964½

The Cougar II, a sporty two-seater introduced by Ford recently and pictured here, isn't just a dream car to be shown

at the N.Y. World's Fair and forgotten.

With a growing reputation for introducing spanking-new mid-season models, Ford will bring out two racy cars with long hoods and short overhang in January. A third probably will not be shown until next fall.

The three cars are being developed under the code name Cougar. They will be built with Falcon components, in sedan and convertible form, with a "fastback" sedan due a few months later.

The conventional sedan that will be introduced in January will have a roof line similar to that of the Continental. The fastback will sacrifice rear seat room to sleekness. A bench-type seat will accommodate two. The rear seat back will lift to form a shelf for extra luggage.

A 200-m.p.h. Chrysler

Quietly working on a "performance image" for the Chrysler Corp. are two groups of company engineers—the Ramchargers (for Dodge) and the Golden Commandos (for Plymouth). The company encourages them to fiddle with racing projects—on their own time.

Among the current Ramcharger projects is a small racer being built in Canada. Expected to do 200 m.p.h., it's called the DL-300 after a company engineer named David Long.

The car has an 88-inch wheelbase and an engine mounted almost midway. Rear wheels are independently sprung.

Working not so quietly on a Chrysler Corp. performance image is Ray Nickels. His goal: to put Plymouth and Dodge cars into stock-car championship circles. Nickels—responsible for giving Pontiac its name in stock-car racing—has a 22-man staff and two top drivers, Paul Goldsmith and Len Sutton, who for years drove Pontiacs to victory.

Something new in auto glass

One evening a decade ago a mild-mannered Englishman named Alistair Pilkington got to thinking as he dried his wife's goblets at the kitchen sink. As a result, in the not-too-distant future you probably will be getting glass in your car that's made in a new way.

Research director for a glass firm in St. Helens, England, Pilkington makes glass by pouring it molten on a bed of tin, equally molten. Cooled, the glass is smooth and distortion-free. It needs no grinding and polishing.

Libby-Owens-Ford and Pittsburgh Plate Glass, both purveyors to the U.S. auto industry, are erecting plants to make glass by this "float" process.

This and that

Production snags will delay the first of the consumer-bound Chrysler turbine-powered cars, originally scheduled for last month, until early winter . . . Various auto makers, including Ford, now actually have cars on test without steering wheels—the driver steers by twisting a brace of handles protruding from the instrument panel . . . General Motors, Ford Motor, and Chrysler Corp. all have models of the Wankel rotating combustion engine [PS, Mar. '60] to tinker with . . . Ford recently bought a number of Buick Rivieras as part of an evaluation program for future Thunderbird body designs. The Riviera has a separate body and frame. This is the first hint that Ford may abandon unitized (frameless) construction when it introduces its next big all-new Bird in 1967 models.

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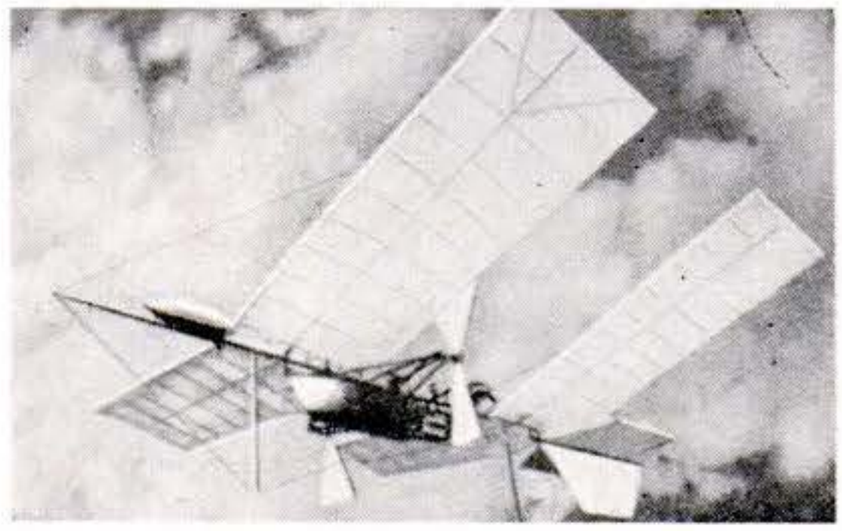
1873 "**The extraordinary performance** of the new Prussian infantry arm, the Mauser gun, is reported by a Berlin correspondent. 'On a distance of 1,500 meters [1,640 yards], out of 480 shots, 399 hits were effected in five targets placed behind each other; and on 1,400 meters [1,564 yards], out of 480 shots, 460 hits are reported. To attack a line in a good position, defended by disciplined soldiers armed with the Mauser, would be the greatest blunder.' "

"**Heredity manifests itself in longevity.** The average length of life depends on locality, diet, and state of civilization; but individual longevity appears to be completely freed from these conditions. It seems to be connected with some inner power of vitality transmitted to individuals by their forefathers. So well known is this fact that, in England, life-assurance companies receive from their agents statements as to the longevity of the applicants' ancestors."

1903 "**In spite of the advance** of biological science and acceptance of the principles of evolution, the notion still prevails that life in other worlds is similar to that of our earth. We find astronomers searching for the absorption bands of chlorophyll in the spectrum of Mars; marks on planets are described as probable vegetation. All this indicates a very contracted view of the nature of life. What we know of terrestrial life gives us reason to think that the same principles which produce life under earthly conditions may produce life of a different type under different conditions; e.g., where the temperature or elements are different."

"**Dr. S. P. Langley** has carried forward important researches in aerodynamics, and has done more than anyone else toward constructing an aeroplane that would fly. A machine was launched in 1896 that stayed aloft two minutes. We reproduce a photograph taken by Dr. A. Graham Bell. The machine's length was about 16 feet, and the width between the wings about 12 feet. The weight was about 30 pounds. The engines could supply 1½ Hp. and the boiler five pounds.

"The Langley aerodrome was not steered nor tried in a breeze nor able to carry any weight. Aeroplanes can doubtless be made to fly; as Lord Rayleigh, quoting Mr.



Maxim, has said, 'it is mainly a question of some time and much money.'

"Aeroplanes will probably be used for military purposes and for adventure, but not for the ordinary uses of transportation and commerce."

1933 "**Cutting into the solid granite** of a 300-foot cliff, workmen under the direction of American sculptor Gutzon Borglum are now putting the finishing touches on the 60-foot head of George Washington, which will form the center of the sculpture group in the Black Hills Memorial in South Dakota."

"**When the 75,000-ton** French liner *Normandie* starts next spring on her maiden voyage west, electrical power equivalent to the combined steam powers of the *Leviathan*, the *Majestic*, and the *Ile de France*, will whirl her giant propellers. Electrical machinery will haul her ropes, raise her anchors, guide her helm.

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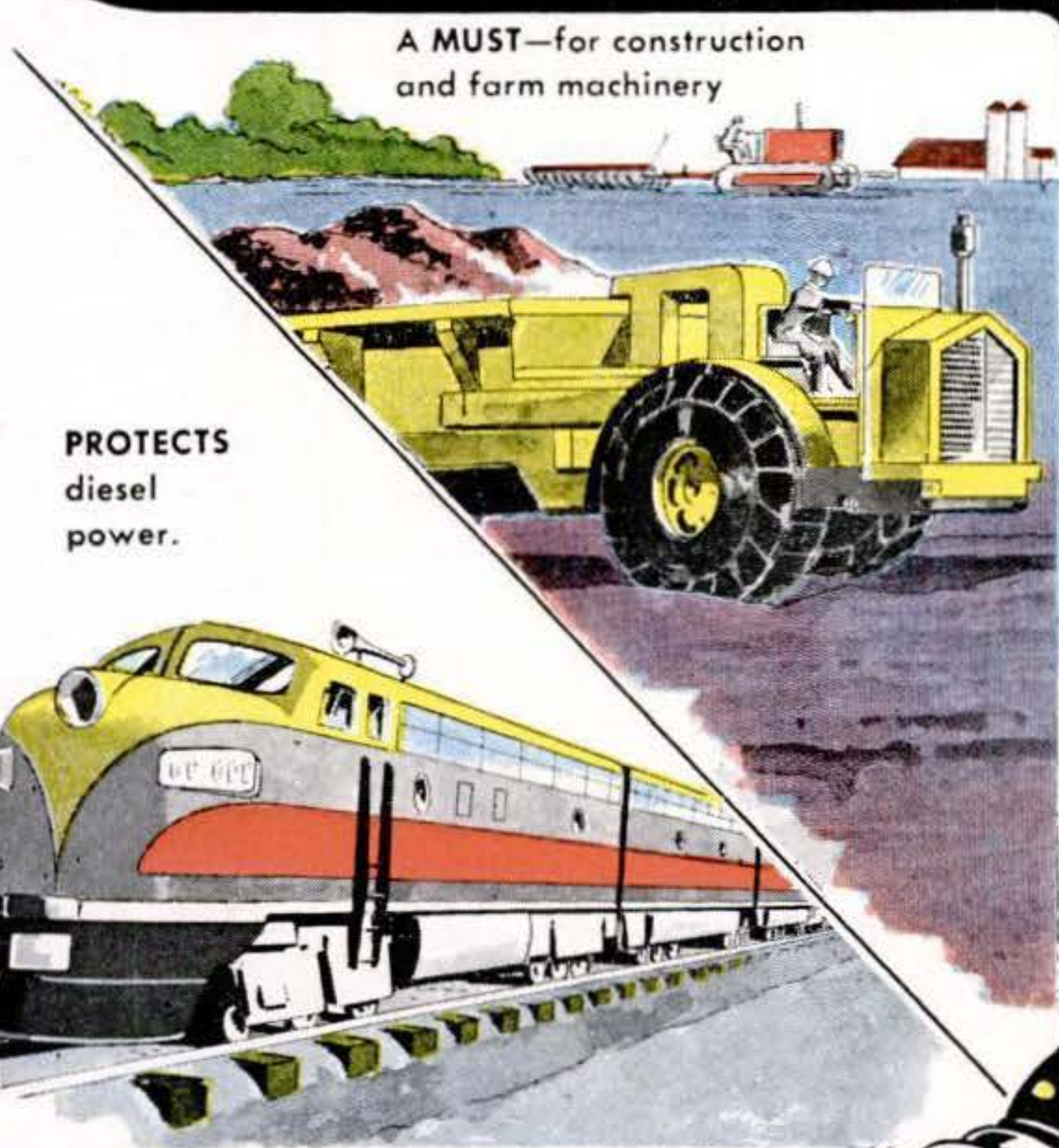

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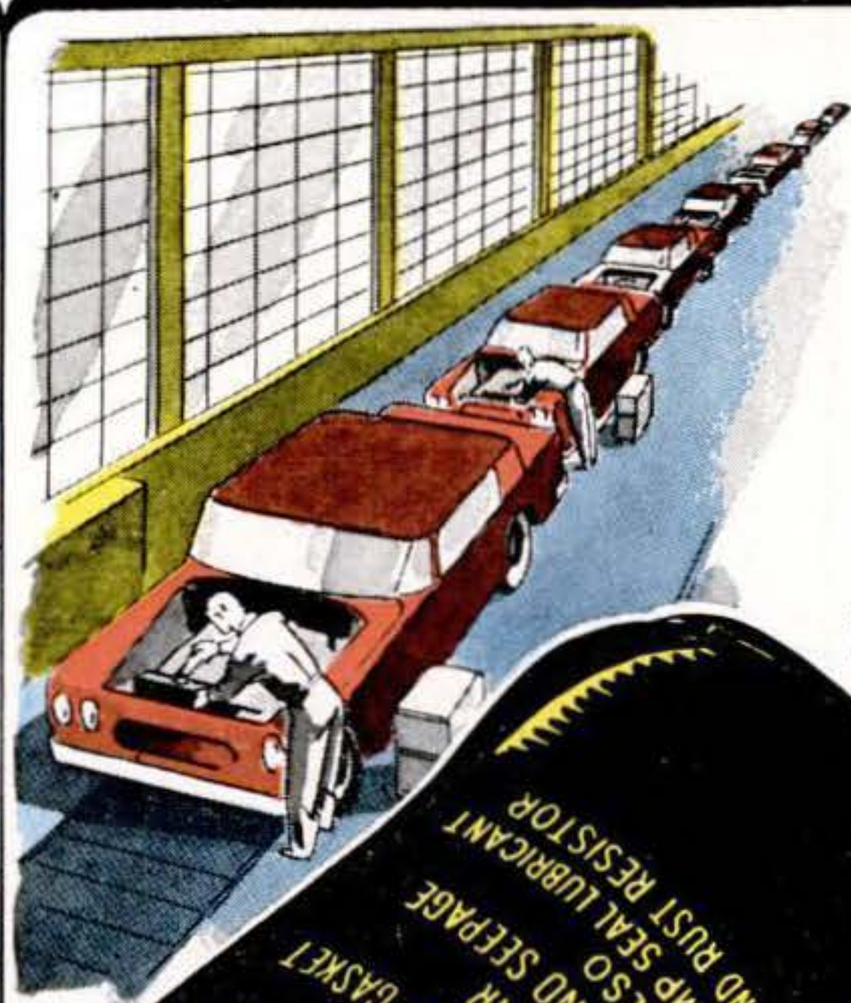

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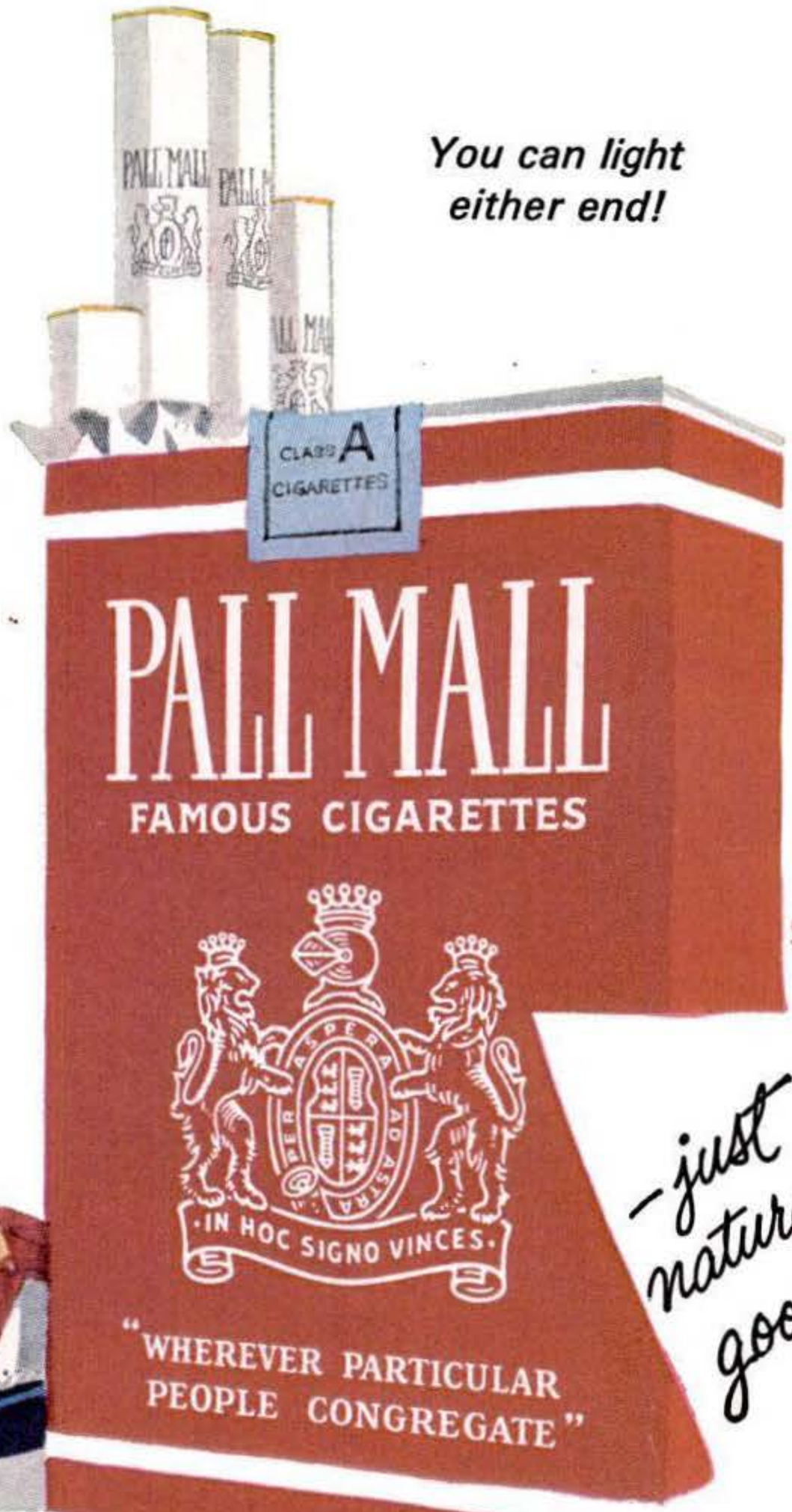

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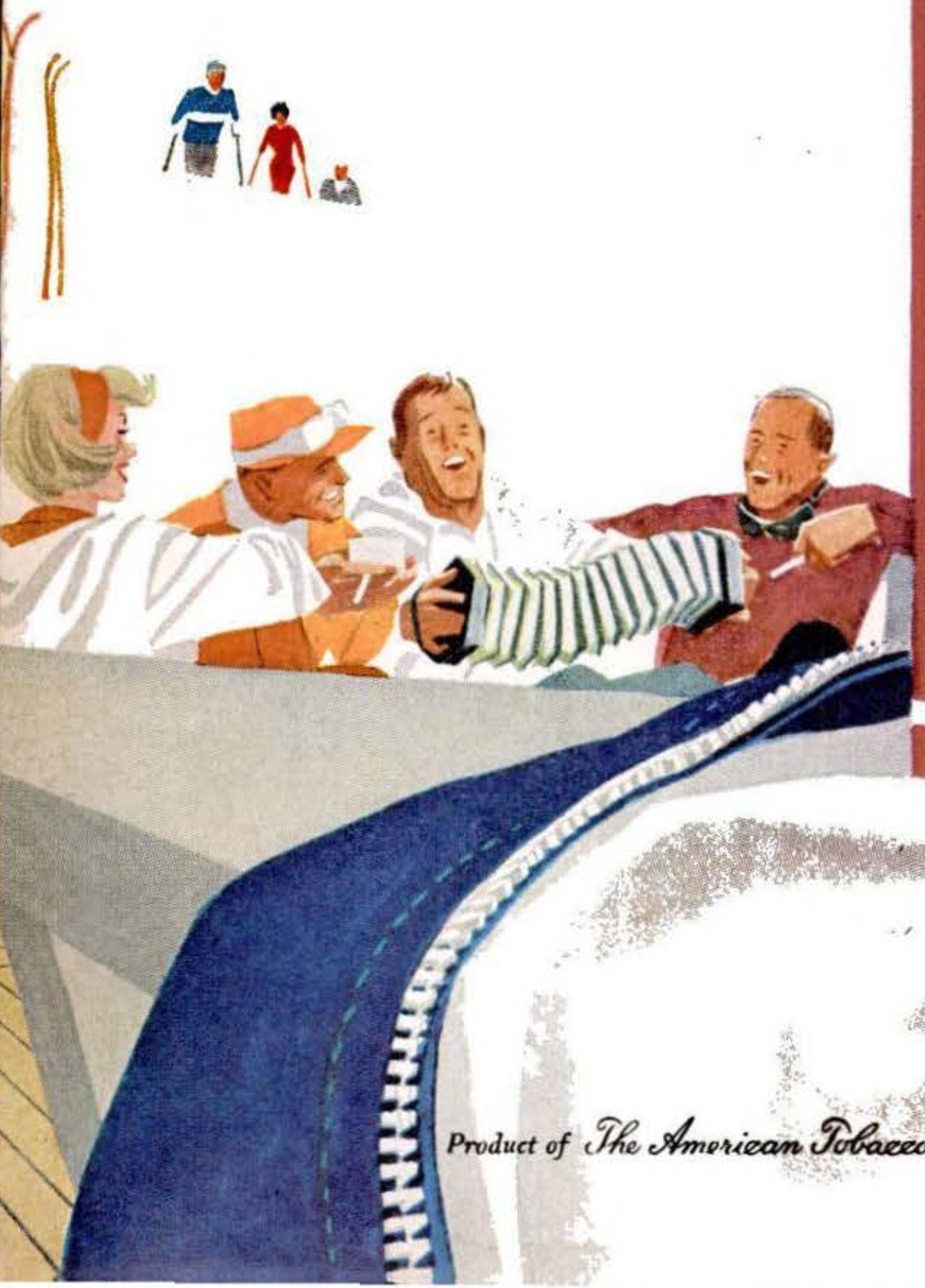

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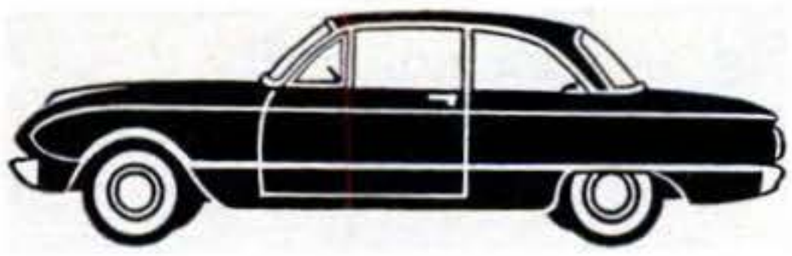
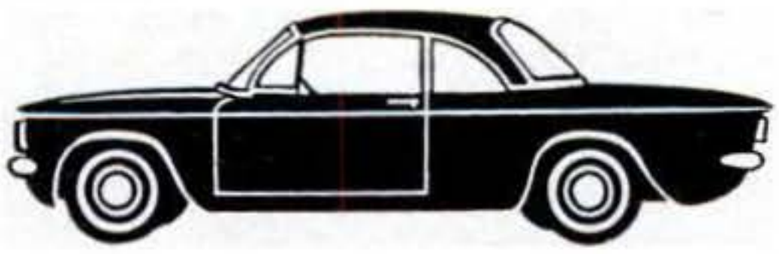
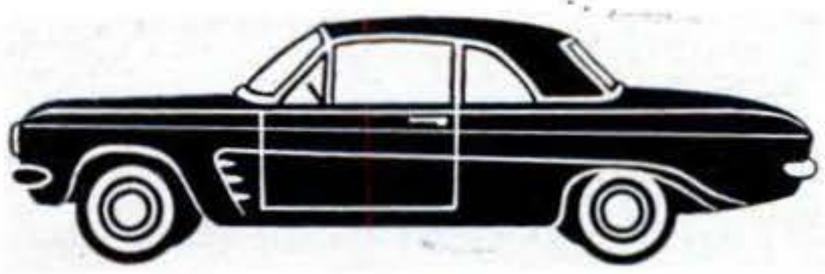
Remember 'way back when...?



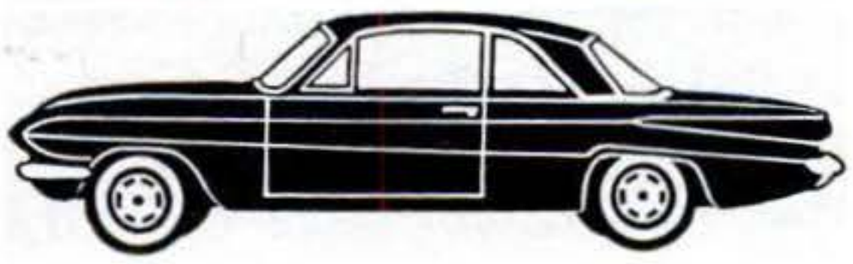
The first Falcon weighed in at 2,396 pounds . . . now it's fattened up to almost 3,000.



Corvair got its push from a meager 80 hp. . . . now you can get it with 95, 110, or 150.



Tempest had only 4 cylinders under the hood . . . now it's a V-8 beast, with up to 348 hp.



Buick Special and Olds F-85 were 188 in. long . . . now they've e-x-p-a-n-d-e-d to 203.

Where, Oh Where, Has My Little Car Gone?

By Devon Francis

IT WAS a great day, that one back in the sparkling autumn of 1959. The frost was on the pumpkin, and the woods were a glory of reds and golds.

For years automobiles put out by U.S. manufacturers had been getting ever-longer, ever-heavier, ever-more muscular. Now things had changed. Detroit had been fetched a clout on the head that left a lump the size of a baseball—trim little cars from abroad were selling over here in the hundreds of thousands. Now Detroit had decided, in irritated reluctance, that maybe there were some customers who didn't like cars as big and as powerful as railroad locomotives.

On that great day of 1959, Detroit at long last introduced a series of little cars. For want of a better word, they were called "compacts."

By American standards, this brood *was* small. Chevy's Corvair measured only 180 inches bumper-to-bumper, Ford's Falcon 181.1, Plymouth's Valiant 184. The standard Chevy was then 210.8 inches long, the Ford 213.6, the Plymouth 209.4.

The new compacts' horsepowers were as modest as their dimensions. The Corvair had 80, the Falcon 85, the Valiant 101. Horsepowers in the standard Chevy, Ford, and Plymouth streaked clear up to 300.

Two existing cars, Studebaker's Lark at a

CONTINUED

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length of 175 inches and American Motors' Rambler American at 173.1, easily qualified as compacts, and in the loose language of the moment the word even covered the regular Rambler at 191.2.

Time marched on. In the next couple of years Detroit made additional affidavit to its change of heart. No less than six smaller-than-normal automobiles appeared: the Buick Special, Mercury Comet, Dodge Lancer, Olds F-85, Pontiac Tempest, and Chevy II.

All this was wonderful. If Detroit was doing penance for its past sins, the motoring public in response was filled with love and forgiveness.

Now let's come down to this model year of 1964. Where, oh where, has my little car gone?

Out of the dozen cars that might be classed as compacts, one—the Lancer—is dead. A new one, the Chevrolet Chevelle, has been added. Strike an average on original lengths of the "compacts" I have listed. It comes out at 185.4 inches. If we take that as a figure to qualify as a small car in the U.S. automotive community, only four—the Corvair, Falcon, Rambler American, and Chevy II—meet the challenge.

So that's unfair? Okay, then put it this way: Only four out of the eight cars introduced as compacts from 1959 up to but not including the Chevelle (and excluding, of course, the lifeless Lancer) have *not* been boosted in size. Or put it another way: Of the 11 cars on the showroom floor today that we have known as compacts since their introduction in 1959 or later, only four have not increased in length.

The smallest of the Larks, the Special, F-85, and Tempest are all 15 inches longer, the Valiant and even the little Rambler American more than four inches longer. The Falcon is up fractionally.

And what of horsepowers? Look: A turbocharged Corvair produces 150 horsepower, a Falcon Sprint 164, a Valiant 145 (with a husky V-8 for this car just in the offing). The Buick Special started out at 155 horsepower. Look at it now—it's available in a 250-hp. version. The Comet, which began at 85 hp., now offers as much at 210. Even the Rambler American, which started with 90 hp., now comes with an optional 138.

The Studebaker people are so sensitive about the prodigious output of their supercharged Lark V-8 that they won't even name a figure. But it smokes rubber when you hit the gas on takeoff.

Where, oh where, indeed?

Confusion, Inc.—A few observations on the

ONE day last June, at a press preview, I was standing around snapping pictures of a bunch of 1964 cars on display by one of Detroit's biggest manufacturers. I took aim at a spanking blue-and-white job.

"Psst!" whispered an engineer. "That's a '63 model." I reddened in embarrassment. "Don't let it bother you," added the engineer. "I often can't tell 'em apart, and I *work* for the company."

The confusion as among year-to-year models is bad. The confusion as among brands is worse. Nowhere except perhaps in women's fashions is there as much copycatting as there is in car styling. The "Thunderbird roof" is a case in point.

Ford snitched this roof from a Chevy model of 30-odd years ago, and now the entire industry has snitched it from Ford.

The Thunderbird roof is strictly a styling gimmick. At the rear, on each side, is a panel enclosure for the greenhouse (the passenger compartment). This is known inelegantly in the trade as an

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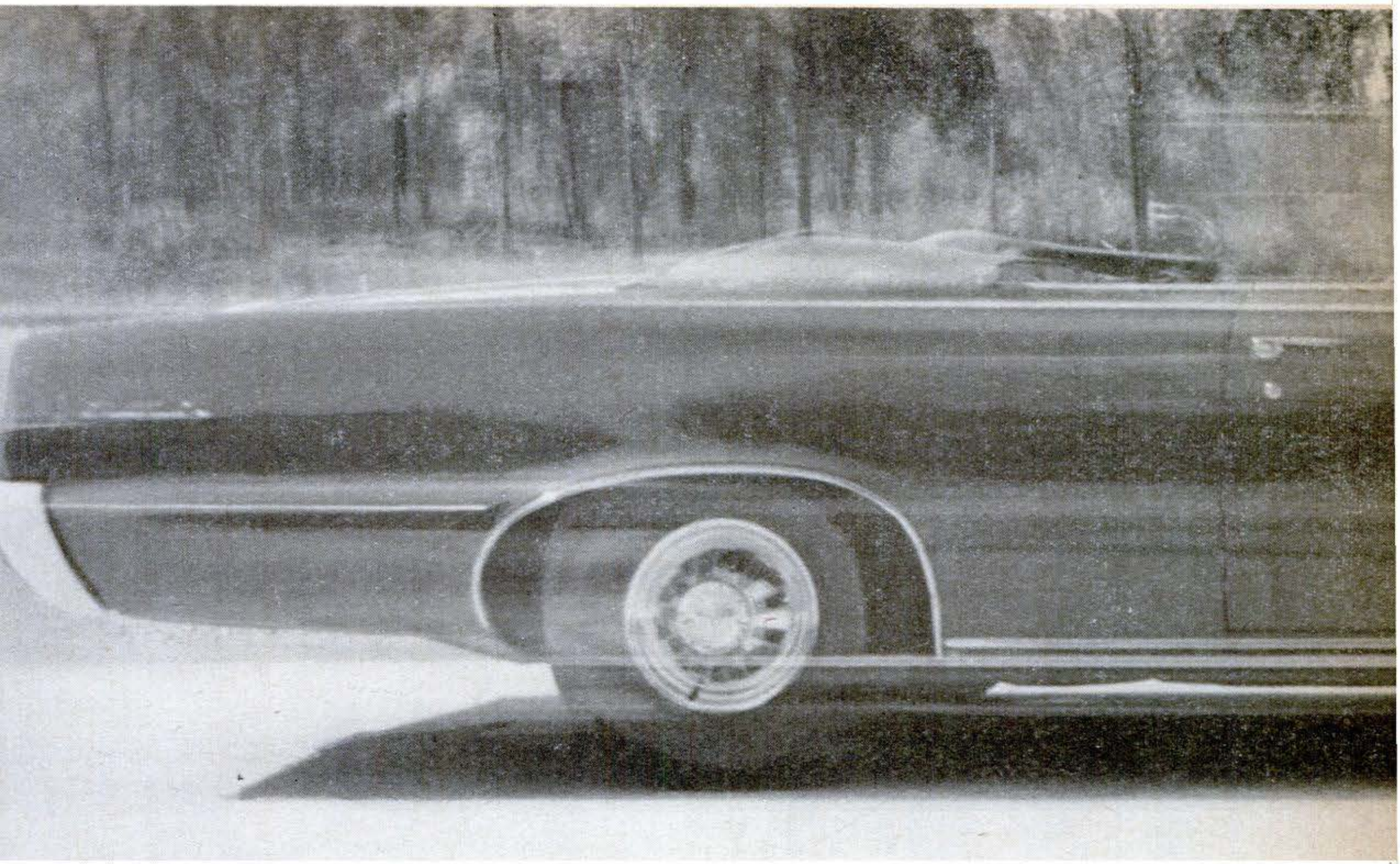

Pontiac's mint-fresh Tempest GTO streaks away from a standing start on an automatic transmission. A manual 3- or 4-speed is available. For a look at the car's front, turn the page.

...This One's Gone to the Races

'64 models by PS's irascible automobile editor

"ear muff." All that ear muffs manage to do is reduce a driver's vision to the rear —and make one brand of car indistinguishable from another.

Another current copycatting is in engineering. It's the thin-walled engine block, notably in the new cast-iron V-8s for the B-O-P (Buick-Olds-Pontiac) lines. This was a Ford development.

"They're all a bunch of thieves!" exclaimed one Ford engineer. "I mean the foundry guys, our guys, and the rest of them in the industry. Not one of them has a speck of company loyalty. Produce something new, and they all come running to see how it's done."

For progress, maybe it's a good thing.

Names, names, names!

If you find it a chore to separate-out the names and numbers hung on the new cars in the showroom literature, you're not alone. Even the people in the business get confounded.

Take Oldsmobile. Olds for '64 has 29

[Continued on page 208]

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FOR long months some of the people who design and manufacture Pontiac automobiles have been smarting under rules against stock-car racing laid down by their parent corporation, General Motors. If they so much as mentioned racing on or off the premises, it was worth their jobs. If a Pontiac executive attended a stock-car race, he wore a false mustache and dark glasses.

Last month the smart was still there. But Pontiac introduced a version of its bigger, sleeker, newest Tempest which unquestionably is going to pop up on stock-car race tracks. It's that fast.

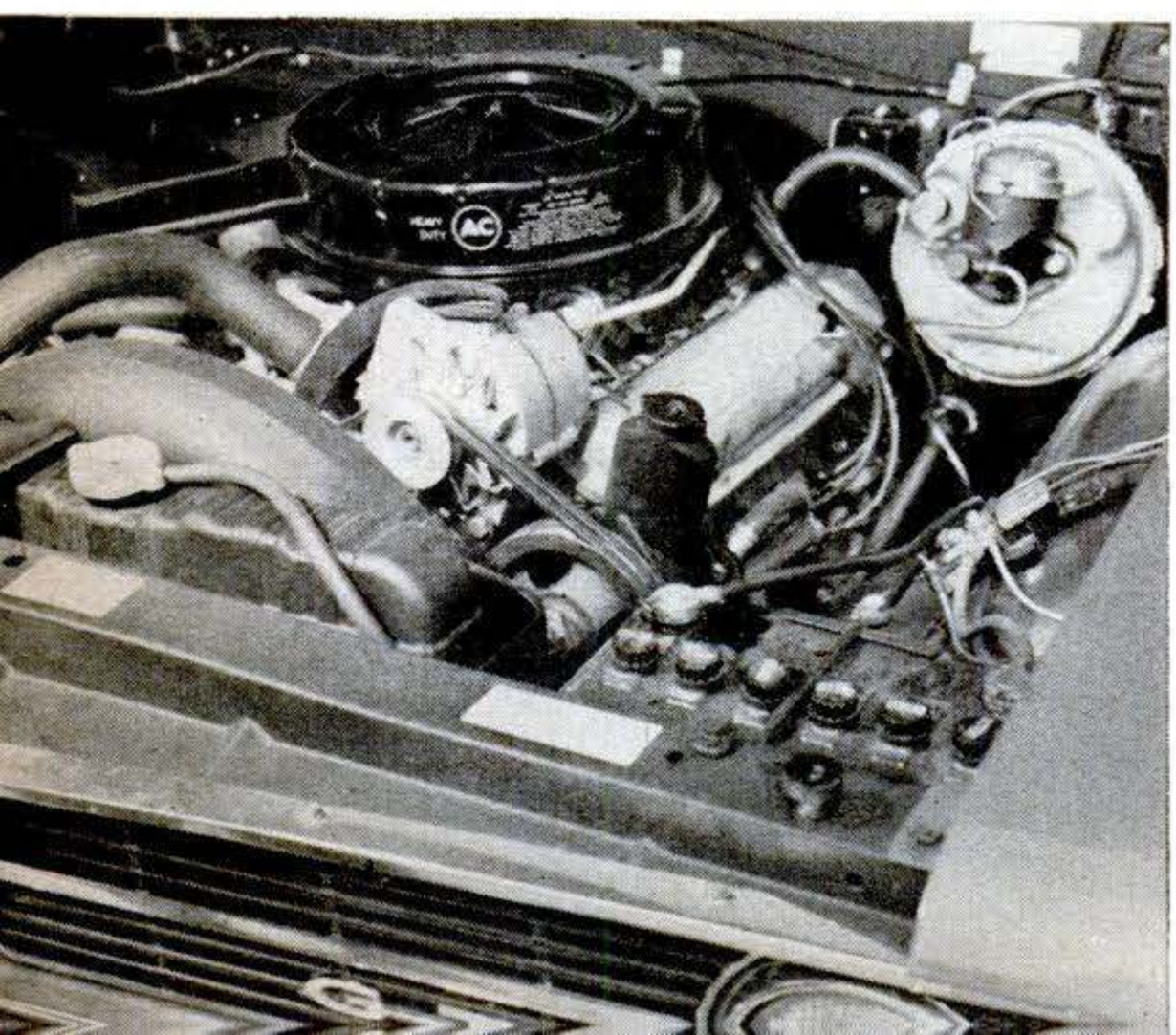
Yet it doesn't violate the rules. It adheres strictly to the letter of the six-year-old agreement drawn up by the Automobile Manufacturers Association and subscribed to by General Motors—that no member of the industry shall engage in, or encourage, racing.

In its 348-hp. version, and with an automatic transmission, this edition of the Tempest, called the GTO (for Gran Turismo Omologato), reaches 100 m.p.h. from a standing start in 19.7 seconds. It goes from 0 to 60 in 6.7 seconds. Put your accelerator foot in the fan, and you leave rubber on the pavement.

The secret: Pontiac's big 389-cubic-inch engine which for six years made racing history.

Pontiac refuses to talk about the top speed of the car, as indeed it refuses to

Most elaborate carburetion produces 428 pound-feet of torque. Compression ratio is 10.75:1 and the standard axle is 3.23:1.



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talk about performance at all. But there is little doubt that in the hands of an owner determined to race it, it could average more than the 160 m.p.h. demanded by the competition in the Daytona 500, the stock-car classic. This puts the GTO in the class with the Fords, Dodges, and Plymouths which for months have had the tracks to themselves.

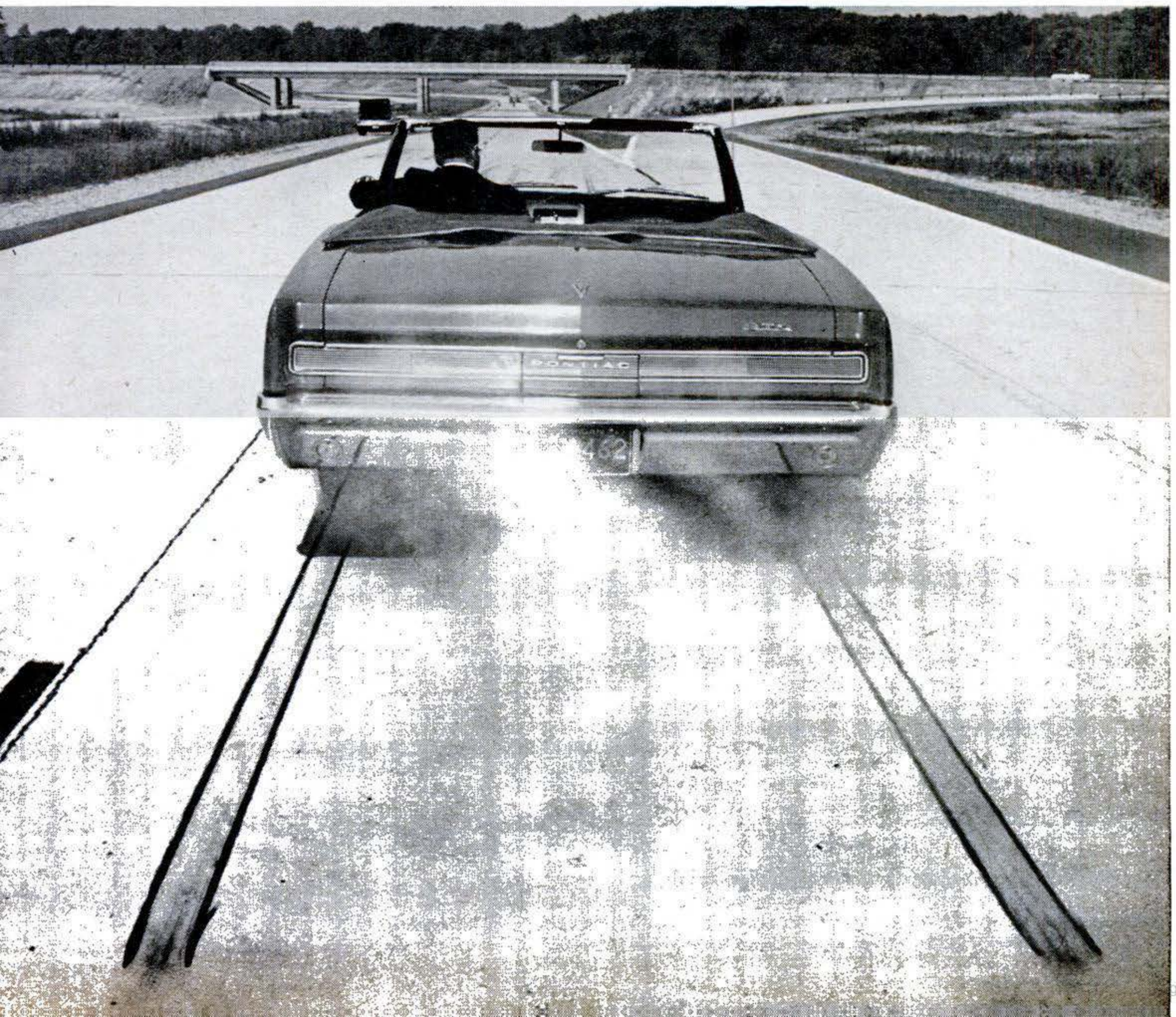
An expert racing mechanic can draw in excess of 400 horsepower from the GTO. This will almost exactly match the Ford Galaxie, a fairly consistent winner of late on the stock tracks, in power-to-weight ratio. The Ford weighs close to 3,500 pounds and puts out about 475 hp. The Tempest weighs only 2,940 pounds. Thus each engine totes slightly more than seven pounds of car per horsepower.

The competition Tempest GTO will

[Continued on page 214]

Between-seats console comes with automatic transmission (above) and some manual versions.

GTO puts trademark on concrete in smoking rubber from nylon tires good for 120 m.p.h.



PS Test-Drives the 'IMP' New Crawl-Anywhere Car

By Alex Markovich

IF YOU like the rugged outdoor life, you're just the man Thiokol Chemical Corp. had in mind when it developed the Imp.

A one-time small producer of polysulfide rubber, Thiokol changed orbits to become a multimillion-dollar giant in the rocket industry—manufacturing engines and fuel for such missiles as Minuteman, Pershing, and Bullpup, and for the X-15 rocket plane. Shifting aim to down-to-earth matters, Thiokol, in its Logan, Utah, plant, builds the brawny tracked vehicles that batter their way through blizzards for the Air Force on the DEW Line and slosh through jungle swamps, polar snows, and across rivers for the Army and Navy.

When Thiokol told POPULAR SCIENCE that it had developed a new midget-size tracked vehicle that could turn on a dime, climb a 45-degree grade, and laugh at mud and snow the way its big brothers can, we asked to be put in the driver's seat. We figured that a vehicle designed to haul two men and 1,000 pounds of gear—1,400 pounds in all—over any terrain might well be the pack animal that hunters, fishermen, ranchers, and weekend explorers have been looking for—even at a price of nearly $3,500.

Came the day of the road test—or, to be accurate, the off-the-road test. We're in the heart of the rugged Utah Rockies. One of the steeper mountains is dead ahead, its scraggy 45-degree slope dotted with sagebrush and juniper.

Platform on tracks. The prototype Imp looks pathetically inadequate. It's nothing more than a platform on tracks with a little engine that goes *pocket-a-pocket-a.* It has neither cabin nor roll bar; these niceties will be available optionally later. Its bright orange finish makes it look as if it came from a toy store for rich little kids.

Ross Eskelson, operations manager at the Logan plant and the developer of the Imp,

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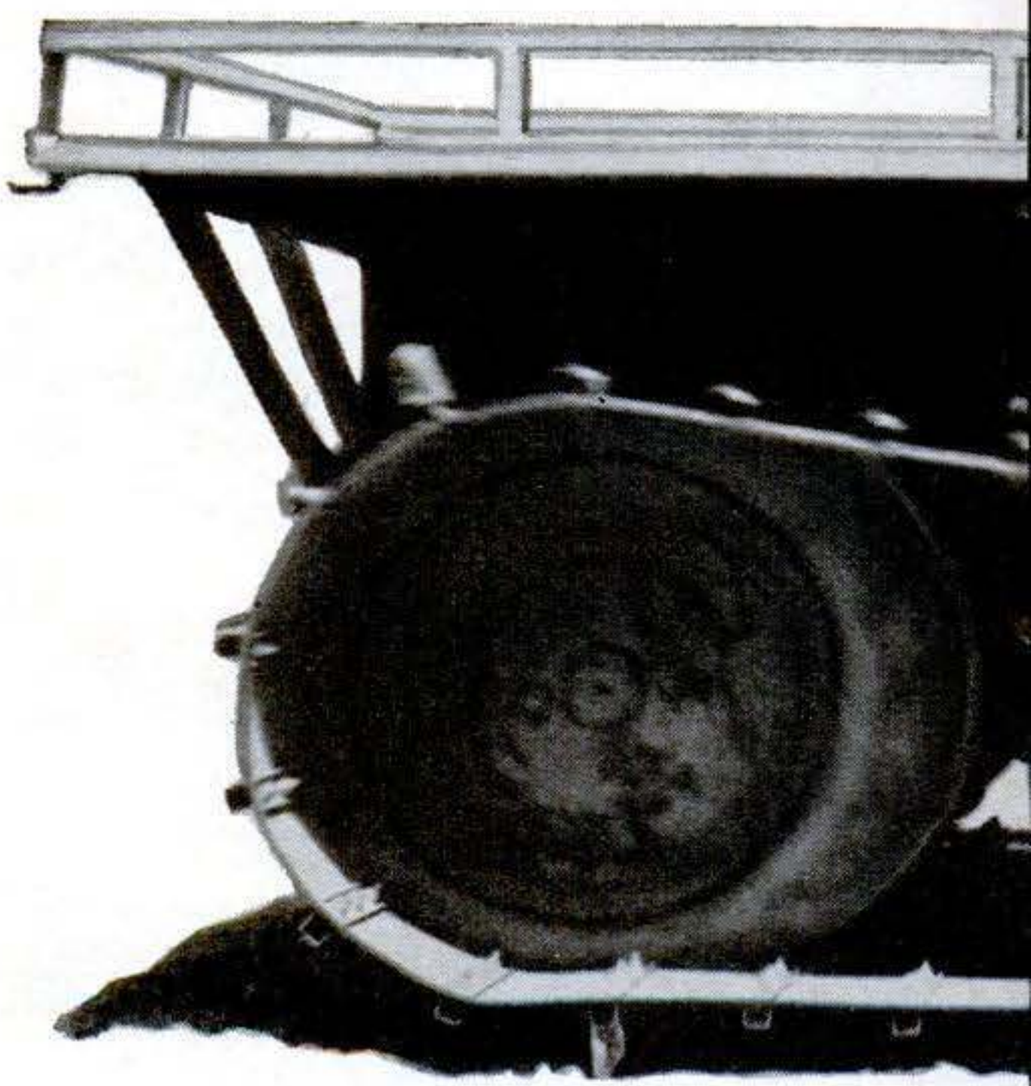
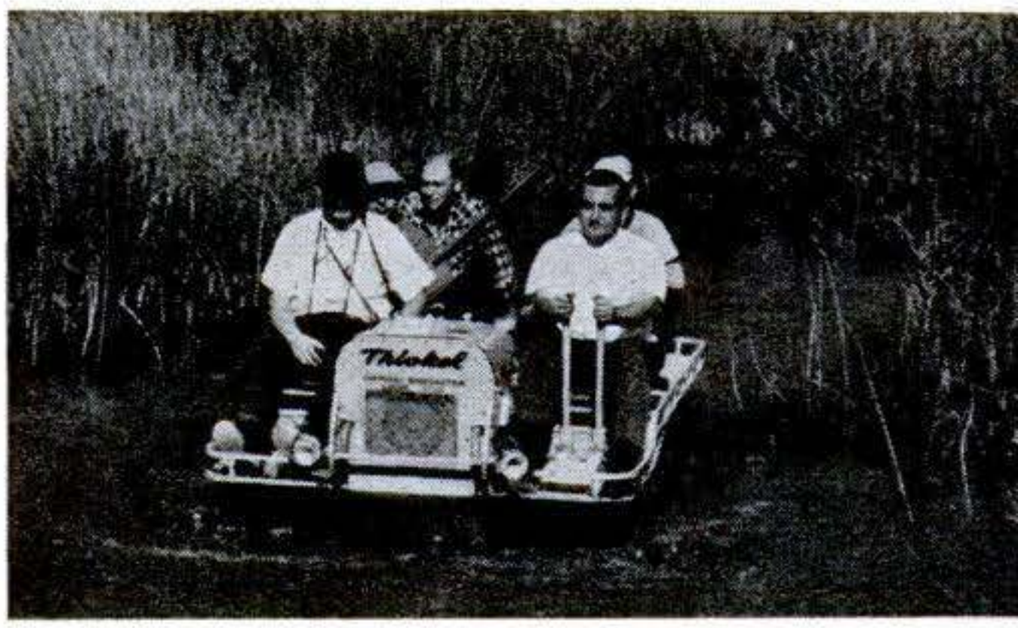


Child's play: up a gravel pile . . .



. . . or wheel-deep in mud and water.

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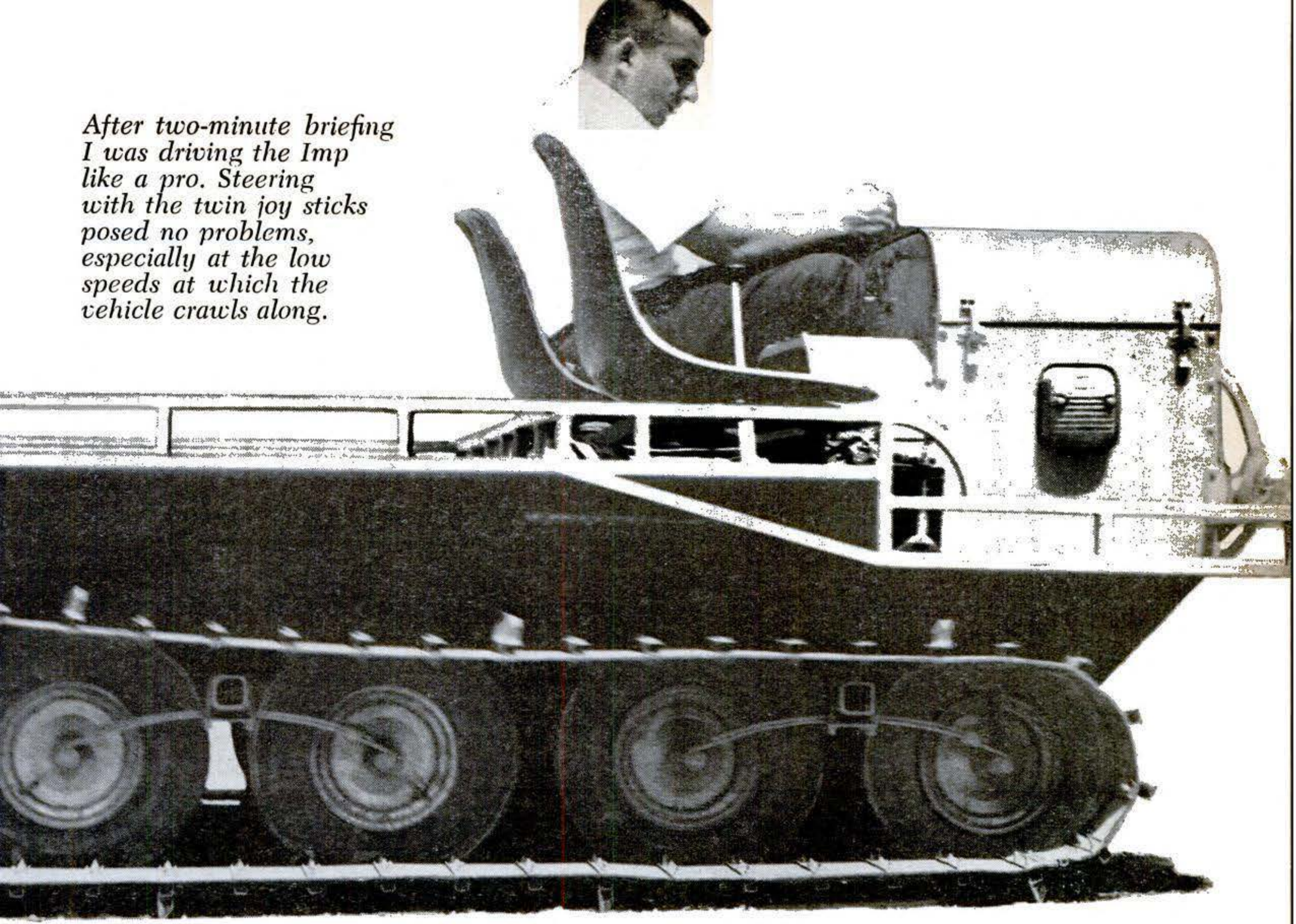
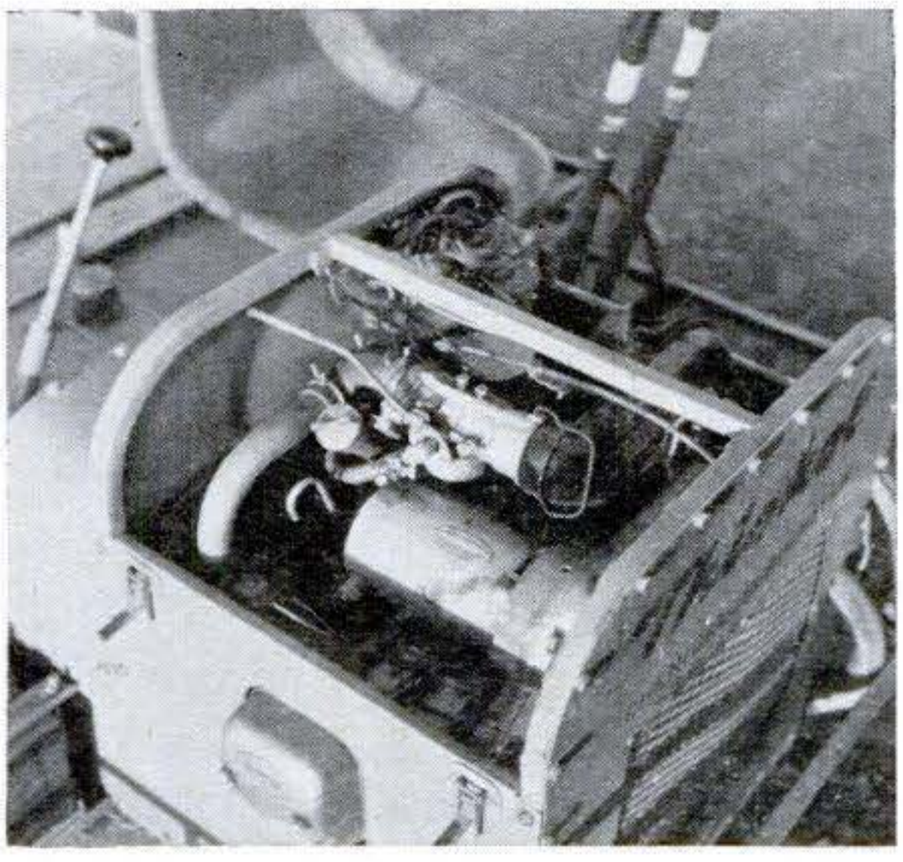
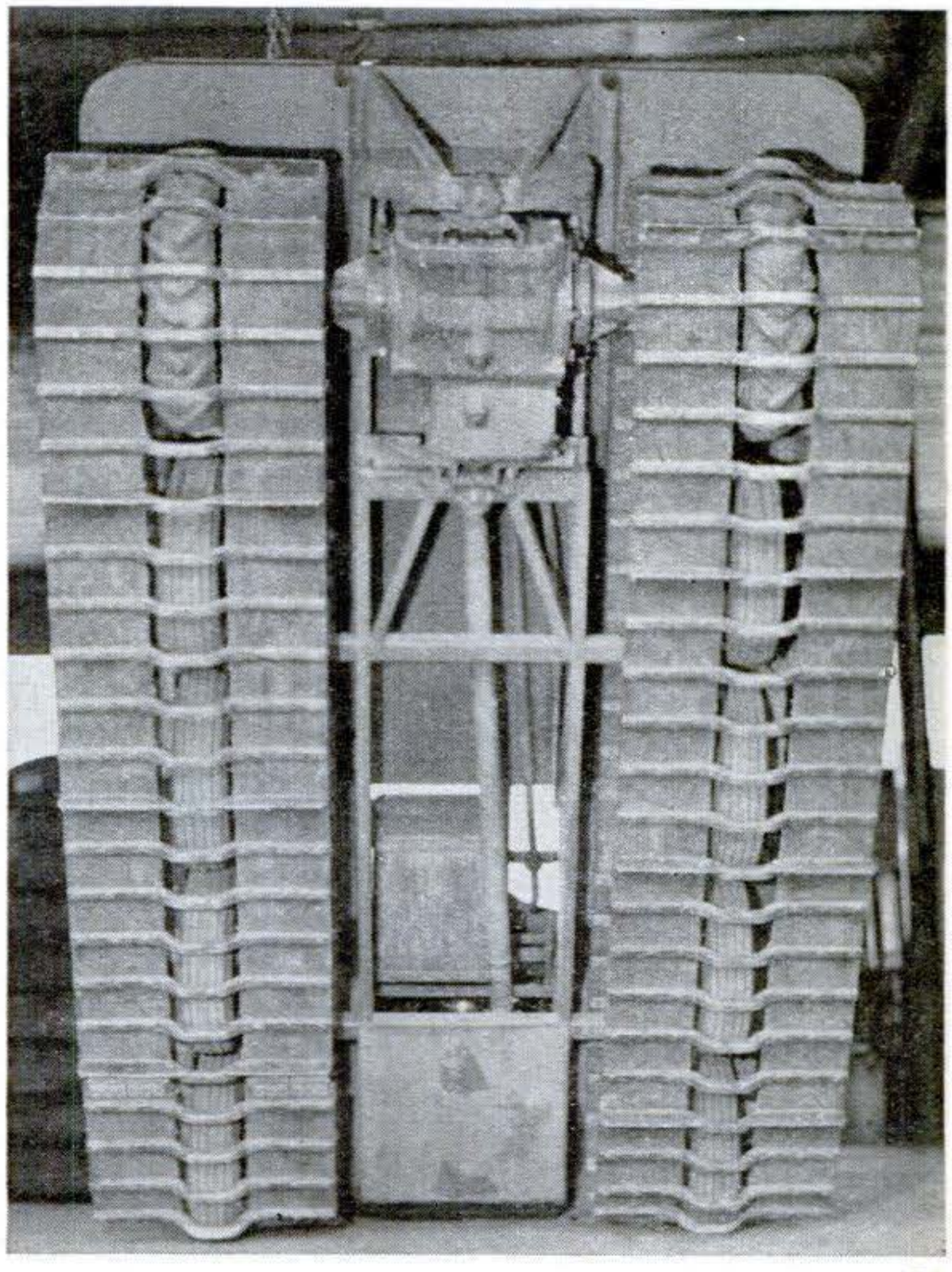
After two-minute briefing I was driving the Imp like a pro. Steering with the twin joy sticks posed no problems, especially at the low speeds at which the vehicle crawls along.



Lifted rear end (right) reveals differential, eccentric drive shaft, reinforced rubber tracks that wrap around small tractor tires. Every sixth cleat is oversized for maximum traction in snow and mud.



Conservatively rated at 18 hp. at 3,600 r.p.m., OMC opposed-twin four-cycle engine winds safely to 5,000. Cylinders are aluminum with cast liners. The power plant weighs only 118 pounds complete.



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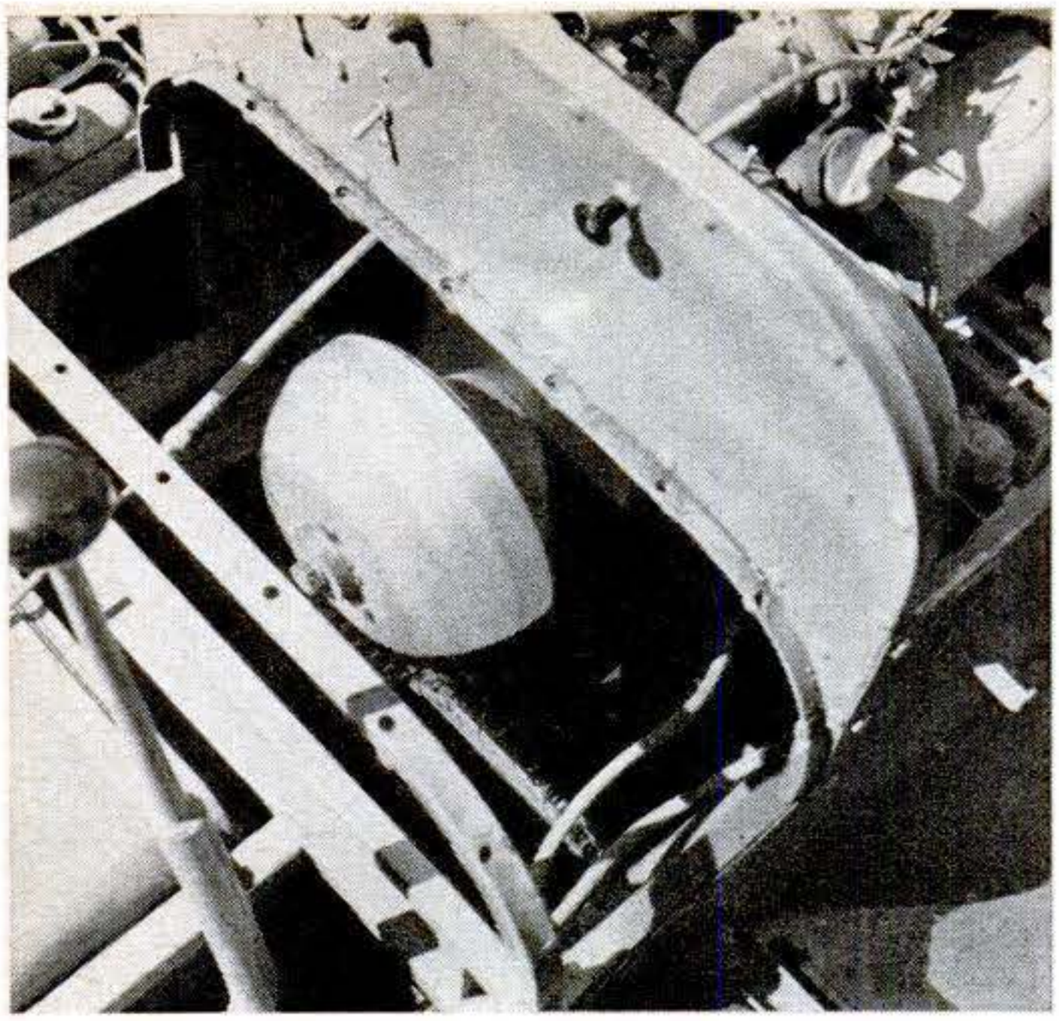
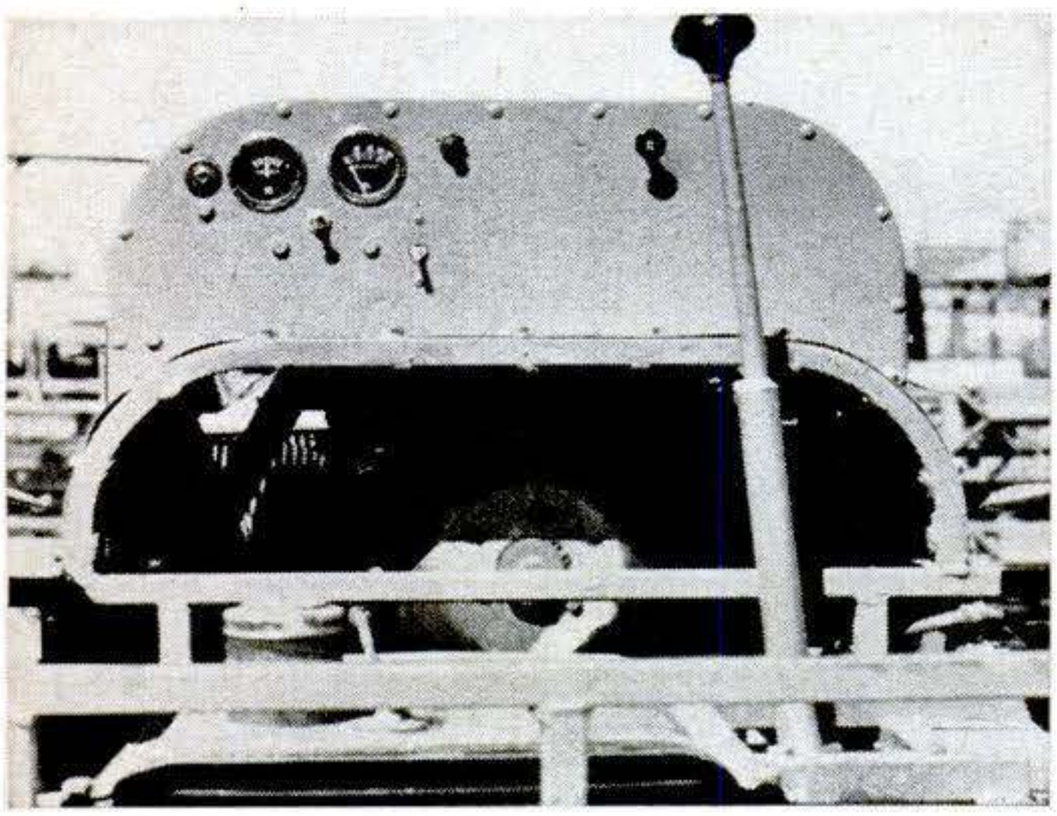
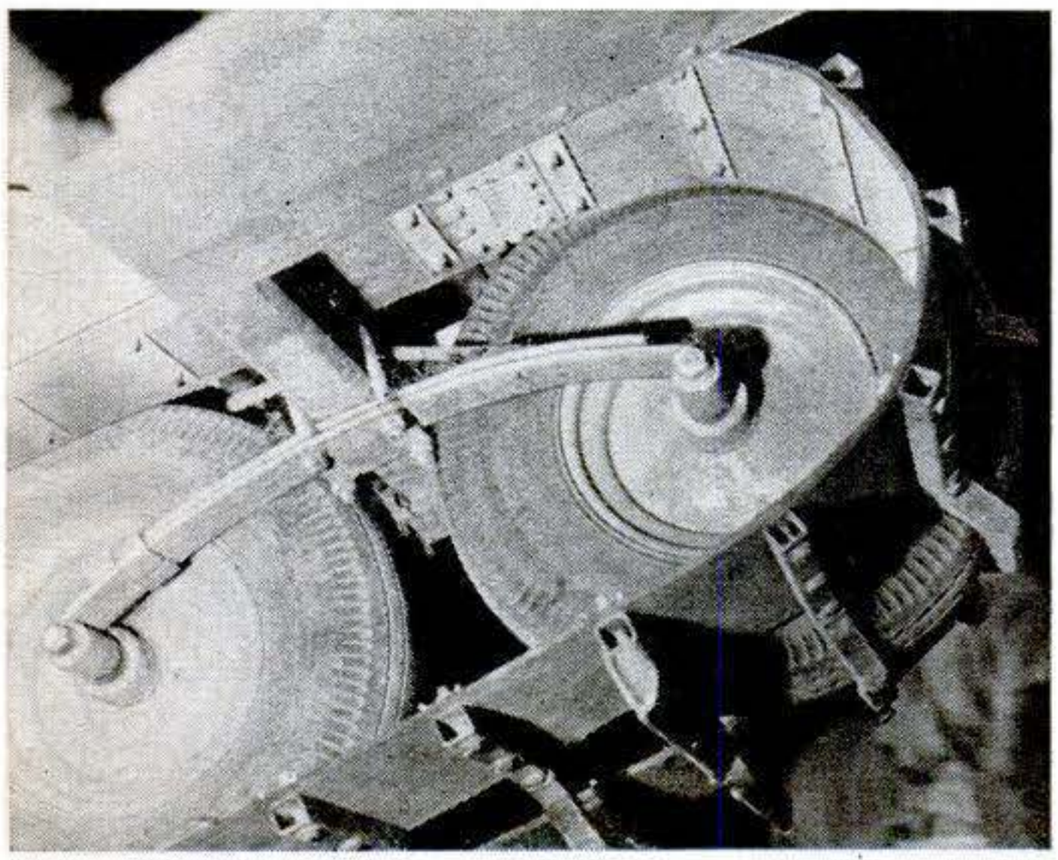


Cover around drive pulley has three ridges. Pulley flyweights are forced to ride along these ridges, providing three gears in addition to transmission.



On the dash: ammeter, oil-pressure gauge, choke, starter switch. Optional: tachometer, hour meter, hand throttle.



Each solid axle carries four wheels. Leaf springs suspend each pair of wheels on either side. Rear axle pivots at center.

pats me on the back reassuringly. "She'll slide before she rolls," he explains.

I'm not convinced, but I give the throttle a hard kick and we go bouncing up the mountain. Out of the corner of one eye I watch Eskelson. He knows the vehicle better than anyone else. I'm set to jump clear at one nervous twitch from him.

But the Imp climbs easily, taking brush and rocks in stride. Top speed is about 15 m.p.h.; climbing in first gear, it's considerably less. But it beats walking.

Steering with joy sticks. I find myself loosening up. Driving this thing is fun. It's easy to get used to the steering and braking; both are handled by twin joy sticks. Pull back on one of the sticks and the track on that side is slowed to about half the speed of the other. To stop, pull back hard on both.

The seats are contoured plastic buckets, unpadded but comfortable. The ride's a bit harsh, particularly on the rock-strewn slope, but Eskelson says it will be softened on production models.

We've reached the crest of the mountain. I kill the whirring engine and we get off to stretch our legs. The small truck that hauled the Imp from the plant is a yellow speck far below. I look down at the slope we've climbed and feel dizzy.

All around are the silent peaks. I'm a city slicker, and I don't remember ever being in a place as quiet as this.

Time to go back down. I flip the starter switch. The engine cranks but won't start.

"Guess I forgot the gas," says Eskelson nonchalantly.

"What do we do now?" I ask. Sweat is dripping down my face.

"We'll coast down. Engine vacuum will provide braking."

"Would you like to take her down?" I ask hopefully.

"No, you go right ahead."

I think Eskelson has missed my point. I'm not just being courteous.

Down we go. I'm pulling back on the joy sticks (what a misnomer) for all I'm worth, trying to keep our speed down

[Continued on page 210]

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Dr. von Braun, center, shows Congressmen a model of Saturn V man-to-moon rocket engine.

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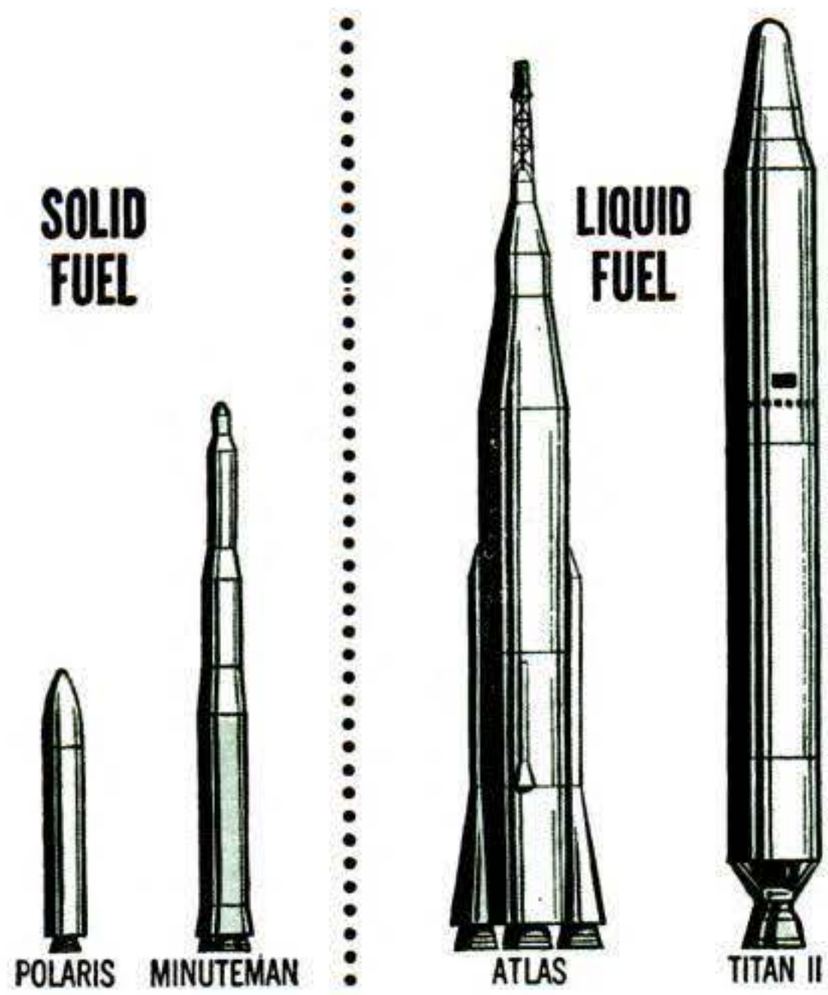
Dr. Wernher von Braun Weighs the Pros and Cons



Q Which is better, a liquid-propellant or solid-propellant rocket?

A That depends entirely on the application. Just as a gasoline engine has advantages and disadvantages compared to a diesel engine, the liquid rocket engine is superior to the solid rocket engine in some applications, and inferior in others. And just as the two types of piston engines are still around, after half a century of heated debate about their pros and cons, it is most likely that 50 years from now there will still be both liquid- and solid-propellant rocket engines in practical use.

The advantages of the liquid-propellant rocket—of which the Atlas and Saturn are examples—lie in its higher performance, its simple shutdown and restart capability, and the fact that it lends itself readily to a number of important control features. For example, the thrust of a liquid-propellant rocket can be varied at will, by throttling the propellant flow, and the rocket can easily be steered in flight by swiveling the relatively small engine or engines.

The advantages of the solid-propellant rocket—the Minuteman and Polaris are of this kind—lie in its inherent simplicity. It need not be fueled just prior to launching. It needs no pressure system or pumps to feed the propellants from the tanks into the combustion chamber, since the rocket's case combines the functions of both. The resulting simplification and speedup of launch preparations makes the solid-propellant rocket especially attractive for military applications where quick response may be vital.

What are the solid propellants?

The Chinese, who are credited with the first demonstration of rockets in the 13th century, probably used black powder. That age-old concoction of charcoal, sulfur, and saltpeter was faithfully used in all war, signal, and ship-rescue rockets until the end of World War I. Only in 1918 did the American, Robert H. Goddard, first try to burn *smokeless powder* in rockets. And only after World War II did the chemical industry come forth with high-energy composite propellants that enabled solid rockets to in-

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vade the field of long-range ballistic missiles, hitherto held uncontestedly by the more-powerful liquid rockets—and to force the liquid rockets right out into the even-more-demanding field of outer space.

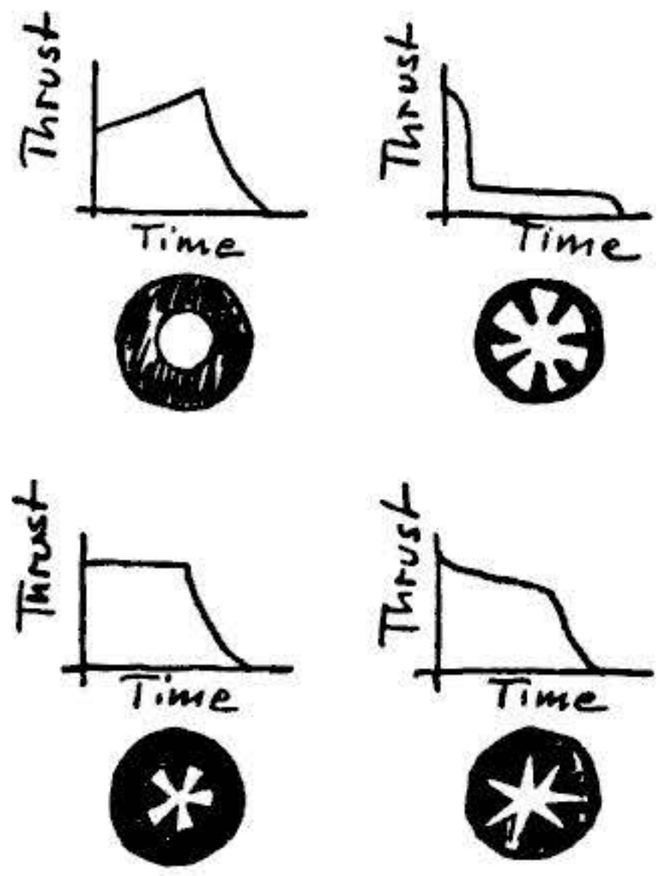
Composite propellants consist mainly of a more or less rubbery fuel binder, in which saltlike crystals of oxidizing agents are embedded. A typical mixture may contain as much as 80 percent by weight of these particles and still retain an amazing degree of plasticity.

There are several types of fuel binders, which differ in performance, price, high and low temperature qualities, storability, and so forth. The one quality they all have in common is long names. There are vinylpolyester, polyurethane, and polyvinyl chloride binders, just to name a few. The oxidizing agents, not to be outdone, bear labels such as ammonium perchlorate, ammonium nitrate, or potassium perchlorate. To increase combustion temperature and fuel performance, aluminum powder is sometimes added to the mixture. Finally, composite propellants usually contain a small percentage of additives to serve as combustion catalysts, chemical stabilizers, or flash suppressors, or to provide certain physical properties otherwise lacking.

Q ***What are the principles of designing solid-propellant rockets?***

A Probably the most important rule is Piobert's Law, which states that the flame front always eats its way into the solid propellant in a direction normal (perpendicular) to its surface. Thus if we fill a tube completely with rocket propellant, and light it at one end, the propellant burns down the length of the tube like a cigarette.

Suppose we drill a hole all the way along the center line of the "grain" (that's what solid-rocket men call the propellant loaded into the "case"). Then if we flash an igniter jet down the length of this tunnel, the flame propagates in a radial direction, and will finally reach the outer wall at the very instant all the propellant is consumed. With the increasing diameter of the tunnel, the combustion surface increases. Consequently, the combustion gas produced per second, and the thrust generated by it, will be smallest at the moment of ignition and largest at the moment of burnout.



Grain cross sections for a number of desired Thrust-time curves

Usually a solid-propellant rocket is designed especially for a kind of performance most likely to be wanted. This means that there is a certain desired relationship between thrust and time. For instance, there may be a requirement to have the maximum thrust at takeoff, when the rocket is heavy, and to have the thrust taper off as it gets lighter. To meet such specifications, rocket designers have developed all kinds of sophisticated grain cross sections, along which the flame front may proceed, to create the desired combustion surface at any given instant (see my sketch). Occasionally this method is further refined by the use of two or more layers of propellant with a different "linear burning rate"—the speed at which the flame front eats its way through the propellant, in inches per second.

Steering solid-propellant rockets

Control of the rocket in flight can be accomplished in a variety of ways. Small ballistic, short-range "barrage" rockets are usually fin-stabilized like an arrow, or spin-stabilized like a bullet. Larger medium, long-range, or antiaircraft rock-

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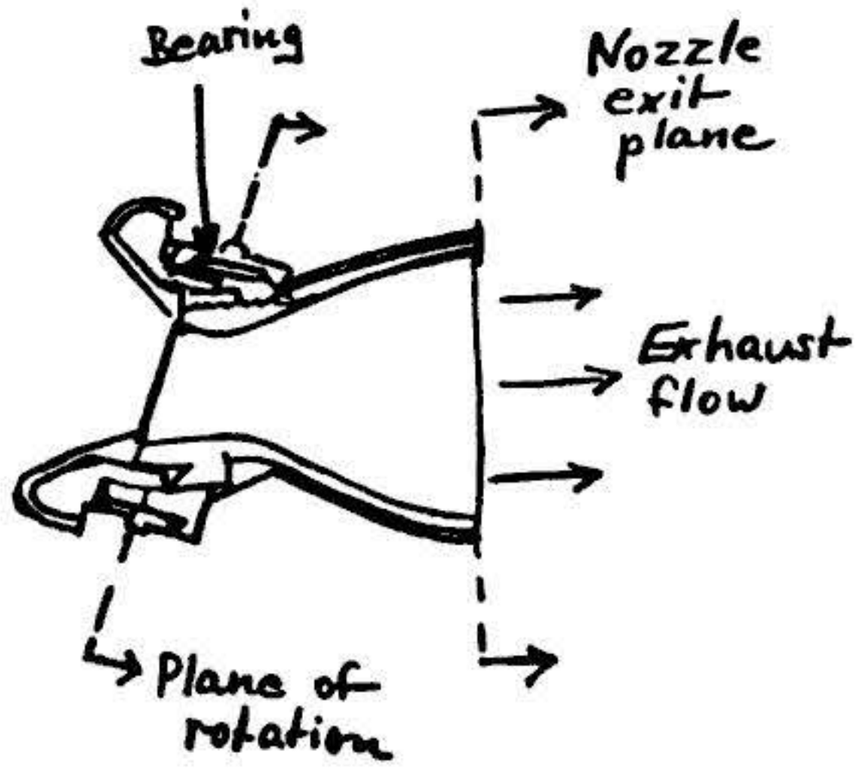
ets with sophisticated inertial or radio guidance systems, however, need a suitable mechanism to convert the electrical steering signals into forces powerful enough to change the rocket's flight path. Aerodynamic control surfaces alone are usually not sufficient; they are ineffective right after takeoff, as well as in the vacuum of outer space. So flat jet vanes or pivoted ring-shaped "jetavators," which can be tilted so as partially to deflect the jet from the nozzle, are often used.

Some of our large solid-propellant long-range ballistic rockets utilize several parallel nozzles through which the gases from the same rocket engine discharge. In this case, "thrust vector control" is often accomplished by rotating the nozzles. The plane of rotation of such a nozzle is skewed to the nozzle exit plane (see my sketch). The sealing and friction problems involved are easier to overcome than with tiltable nozzles.

Just as important as thrust vector control is the ability to shut off the rocket thrust of a ballistic rocket, after the necessary velocity for the desired range has been reached. This may be done by "thrust termination"—for instance, by blowing off the entire exhaust nozzle, so that the abrupt pressure drop extinguishes the fire. Another method uses "thrust reversal": A number of ports are opened, usually by blasting their membrane covers away. Some of the escaping exhaust gases discharge in the forward direction, with their total backward thrust exceeding the remaining forward thrust. Since the warhead is simultaneously released, this technique in effect backs the spent rocket away from the nose cone, at the moment the desired speed is reached.



Casings of solid-propellant rockets are usually made of high-strength steel, titanium, or wound fiberglass.

Q ***What is a hybrid rocket?***

A It is a crossbreed between a liquid-propellant and a solid-propellant rocket, in that it uses one liquid- and one solid-propellant component. Usually it has a solid-fuel grain against which a liquid oxidizer is sprayed. Sometimes the arrangement is the other way around.

Hybrid rockets offer a number of potential advantages. Their nozzles can be cooled by the liquid component, which may result in substantial weight savings over the heavy uncooled nozzles of long-burning solid-propellant rockets. Then, the thrust of a hybrid is easily controllable by throttling the liquid component. With the same throttling valve, the rocket can also be turned off competely, and started again—the latter trick still being beyond the reach of any solid rocket.

Certain liquid components suitable for hybrid rockets—whether fuel or oxidizer—can also be used as monopropellants. That is, on being fed through a suitable "catalyst bed," they decompose into a moderately hot gas. This feature can be used for numerous auxiliary purposes: tank pressurization, pneumatic-control pressure, attitude-control nozzles, vernier thrust for precise guidance maneuvers.

For all their potential, hybrid rockets still have failed to find much practical application. Many designers feel that they merely share the disadvantages of the low-energy solid-propellant rockets and the highly complex liquid-propellant rockets, and thus are not too attractive. Others believe that there will be applications in which the hybrid rocket will prevail. ■ ■

Dr. von Braun will consider answering questions from readers of POPULAR SCIENCE in the magazine, but he cannot undertake to answer each one by mail. Letters to him should be addressed in care of POPULAR SCIENCE, 355 Lexington Ave., New York, N. Y. 10017.

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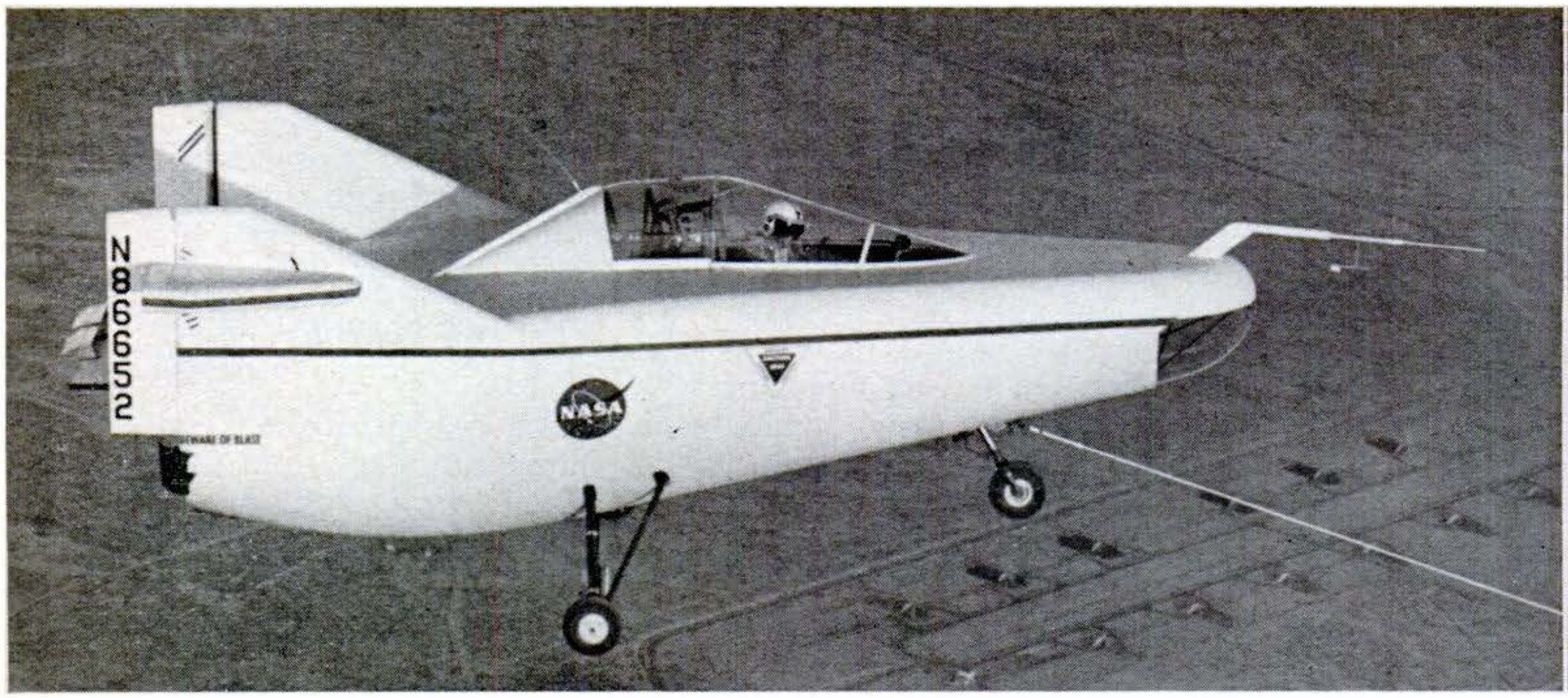

M-2 glider is towed aloft before fast glide back down to Edwards Air Force Base. Wingless craft is made of plywood on a tubular steel framework, has peek-a-boo plexiglas nose for better visibility at high angles of attack. Tow-rope release is under pilot's control.

Flying bathtub

This thing flies? It's the M-2 glider, more commonly called the "flying bathtub" at Edwards Air Force Base, Calif., where the stubby craft is being flight-tested by the National Aeronautics and Space Administration.

The boat-tailed "lifting body" is being tested as a design for a reentry vehicle that could mush down into the atmosphere from space and land at conventional airfields. The shape is essentially a half-cone with twin rudders, elevons, and flaps for control. With no wings, the aerodynamic lift, such as it is, comes from pressure built up under the entire fuselage as the glider plows through the air.

In a series of test flights, the M-2 has been towed to 13,000 feet behind a DC-3, whereupon test pilot Milton O. Thompson cuts loose. Losing altitude at the rate of 4,000 feet per minute, he circles downward at an air speed of about 135 m.p.h. to land on a dry-lake bed at 80 m.p.h. with a land-

Deep-space rocket-firing is photographed 22,000 miles out

Firing of the "kick motor" aboard the Syncom communication satellite, 22,548 miles out in space, is captured in a remarkable series of photos by the Smithsonian Astrophysical Observatory's tracking station at Olifantsfontein, South Africa. The rocket jolt placed Syncom in its final orbit, in which it hovers continuously over the 55th west meridian because its orbital speed matches the speed of rotation of the earth

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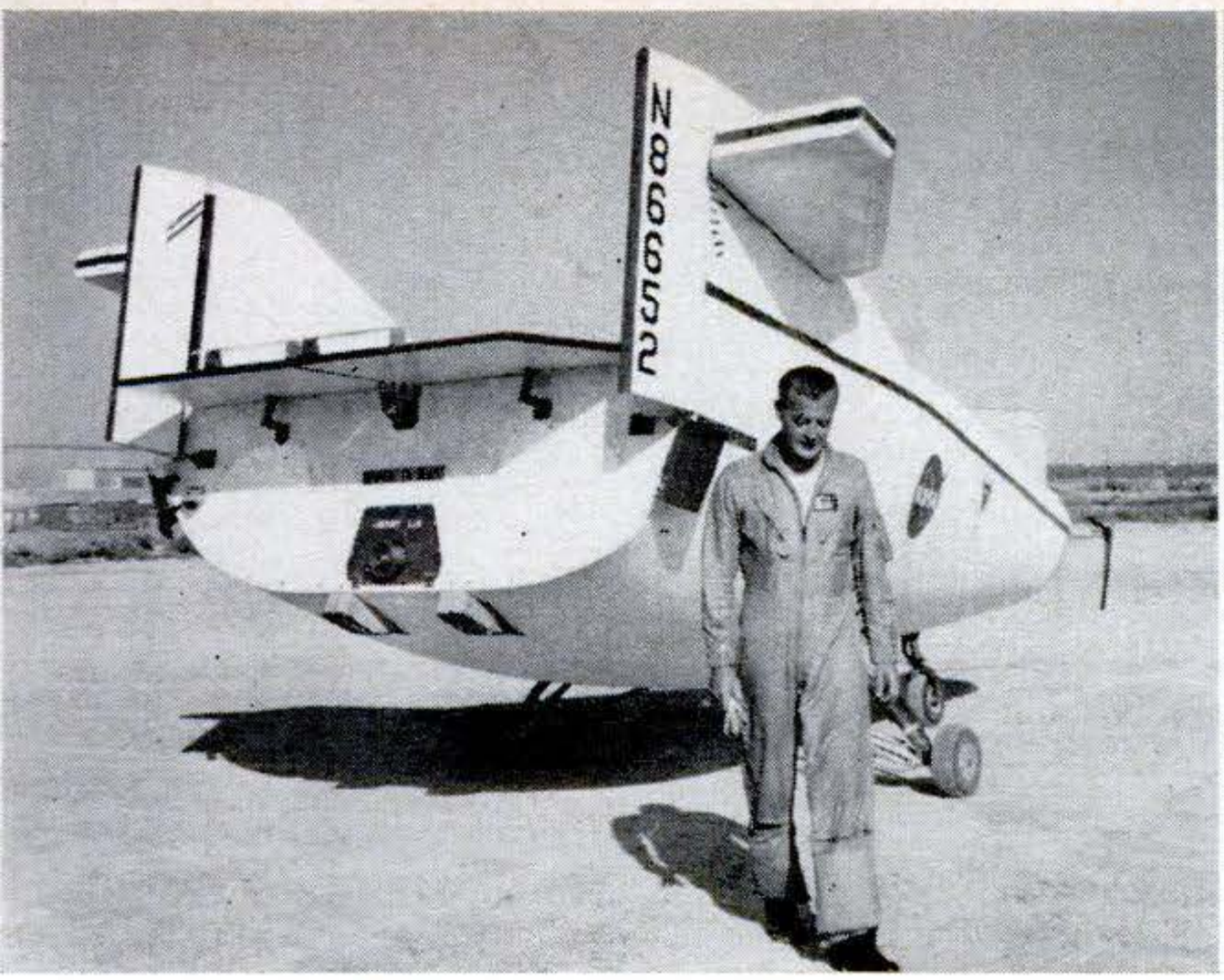

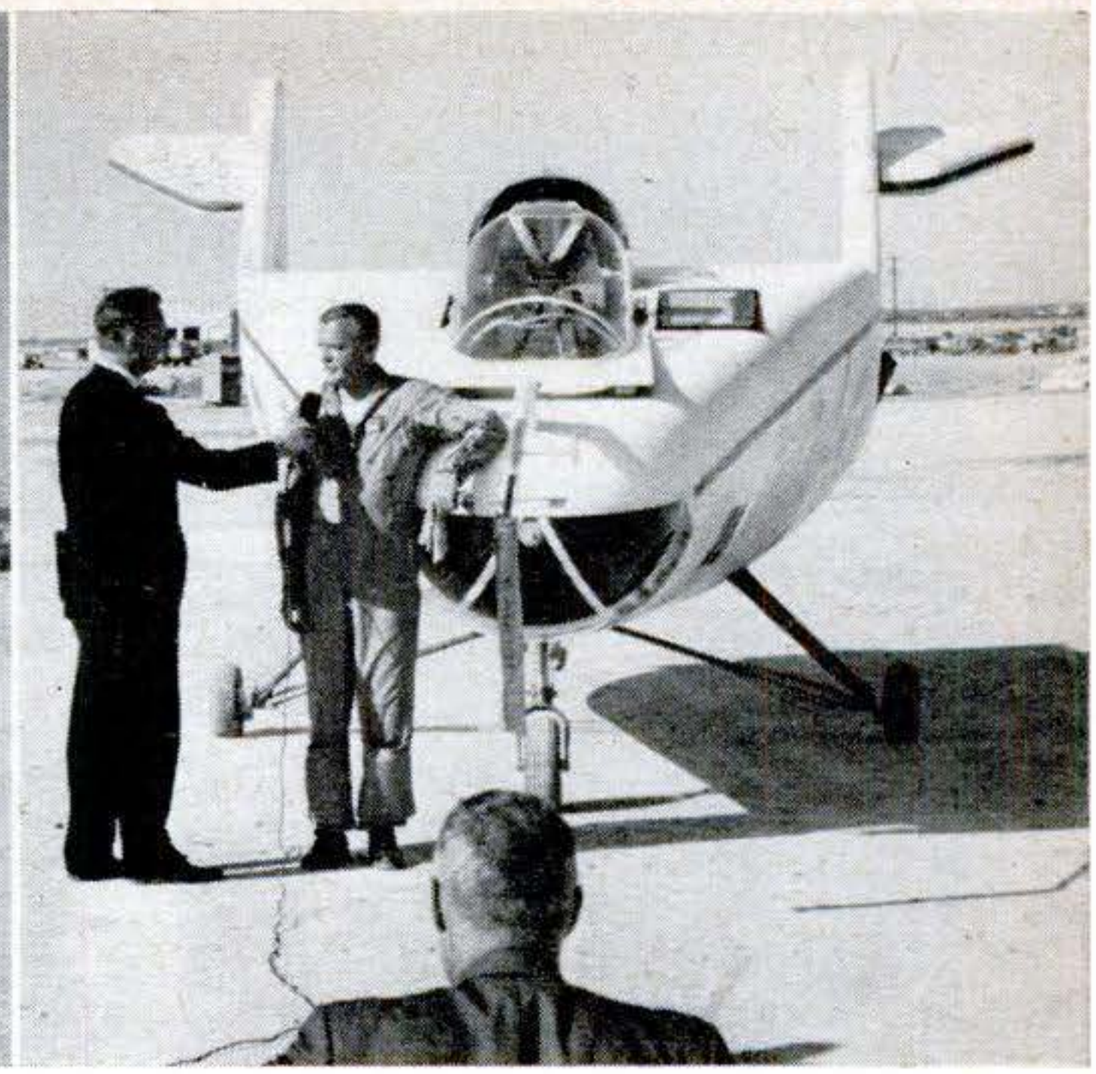

After landing, test pilot Thompson leaves his glider. In stern is small solid-propellant rocket for "instant L/D" (lift/drag ratio) to stretch out landing glide if necessary; Thompson hasn't used it yet. M-2 also has zero-speed, zero-altitude ejection seat for safety.

ing rollout of 250 feet. The bathtub is tricky to fly, Thompson says—there's not much stability—but it's easier to pilot than a paraglider, a kitelike machine that he has also tested.

The M-2 program has cost only $60,000 to date, of which $20,000 was spent on the glider. A larger, metal version may be built, to be dropped from a B-52 like the X-15 and boosted to supersonic speed by a rocket engine before starting its landing glide.

Designed by Dr. Alfred J. Eggers of NASA's Ames Research Center, the M-2 glider is the first of a family of designs for reentry vehicles, or "space ferries," to be piloted to earth; another member is Asset, a stub-winged but unmanned rocket nose cone, first test-fired Sept. 18. The idea is to combine some of the maneuverability of an airplane with a blunt shape that is better able to withstand reentry heating. Many of the designs are evidently derived from the Air Force's Dyna-Soar space glider, being built for manned space flights in 1965 or 1966.—*Wallace Cloud.*

[see "The Stay-Putnik," PS, March '63].

Sequence starts as motor ignites, becoming just visible; the flame was 66 miles long and 33 miles wide just before burnout (fifth photo), 20 seconds later. Slight movement of the satellite can be seen against the background of stars, which look like streaks since the telescope-camera was following the satellite during each six-second exposure.

Launched July 26, Syncom has logged more message time than all other communication satellites combined—it's within communication range all the time.

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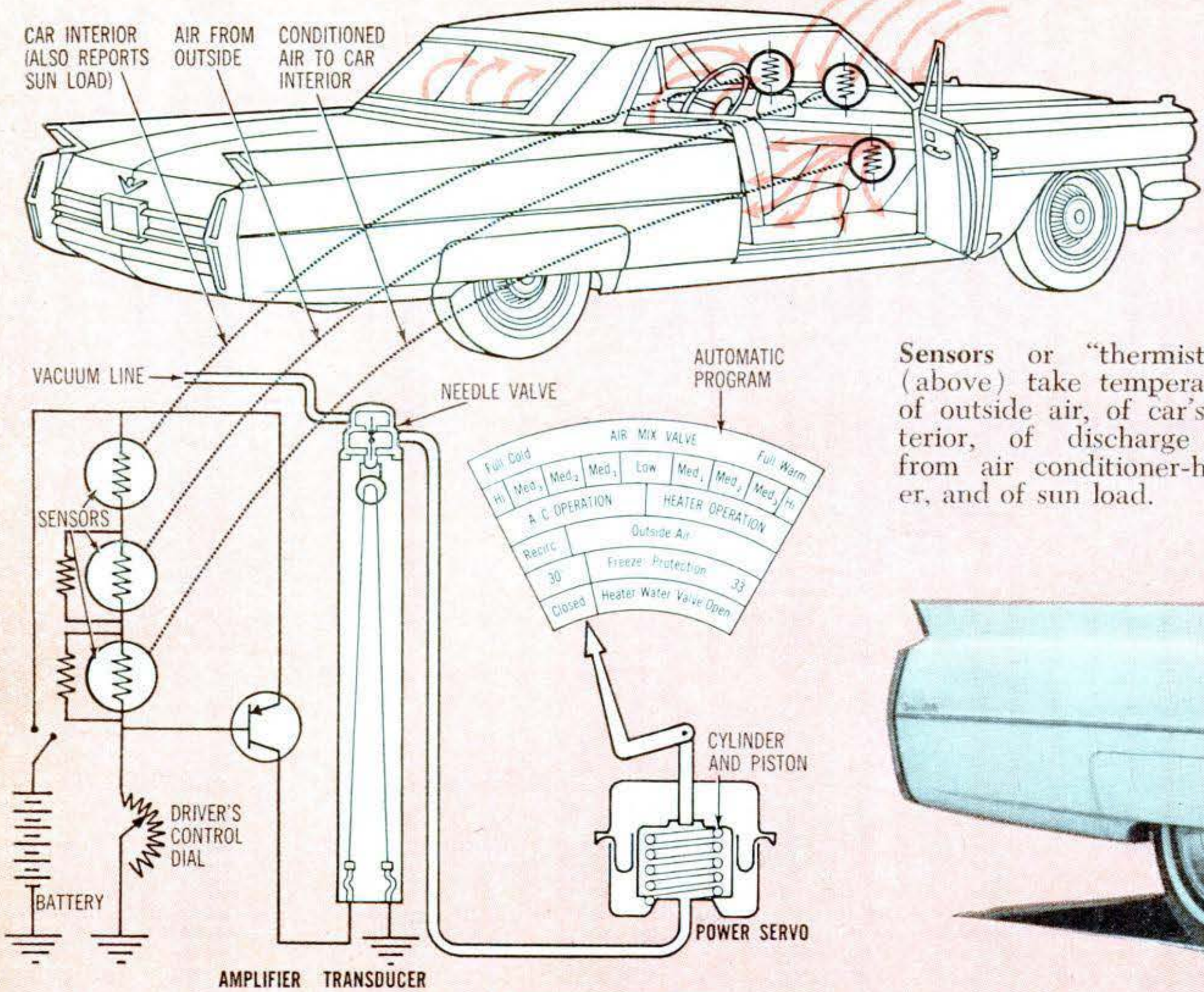
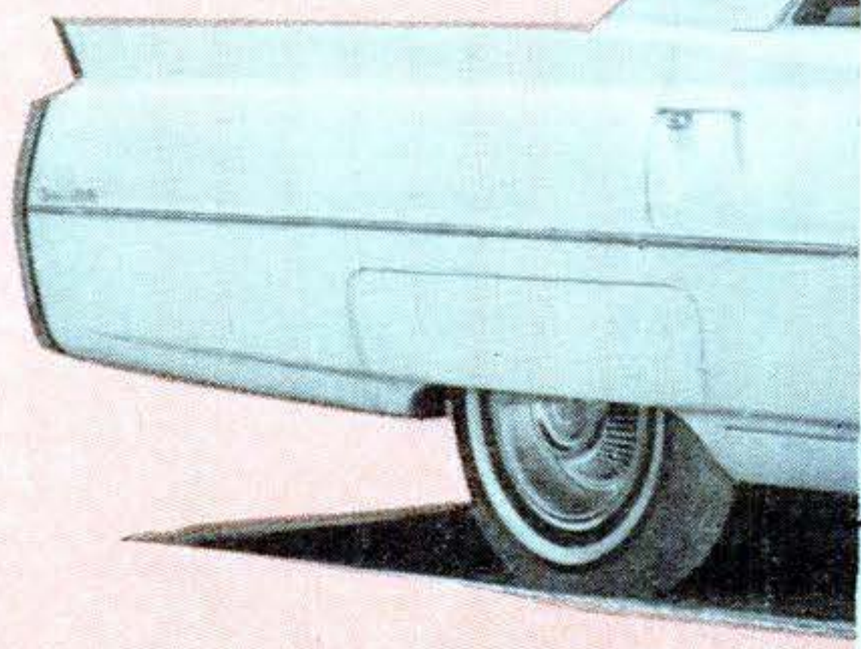
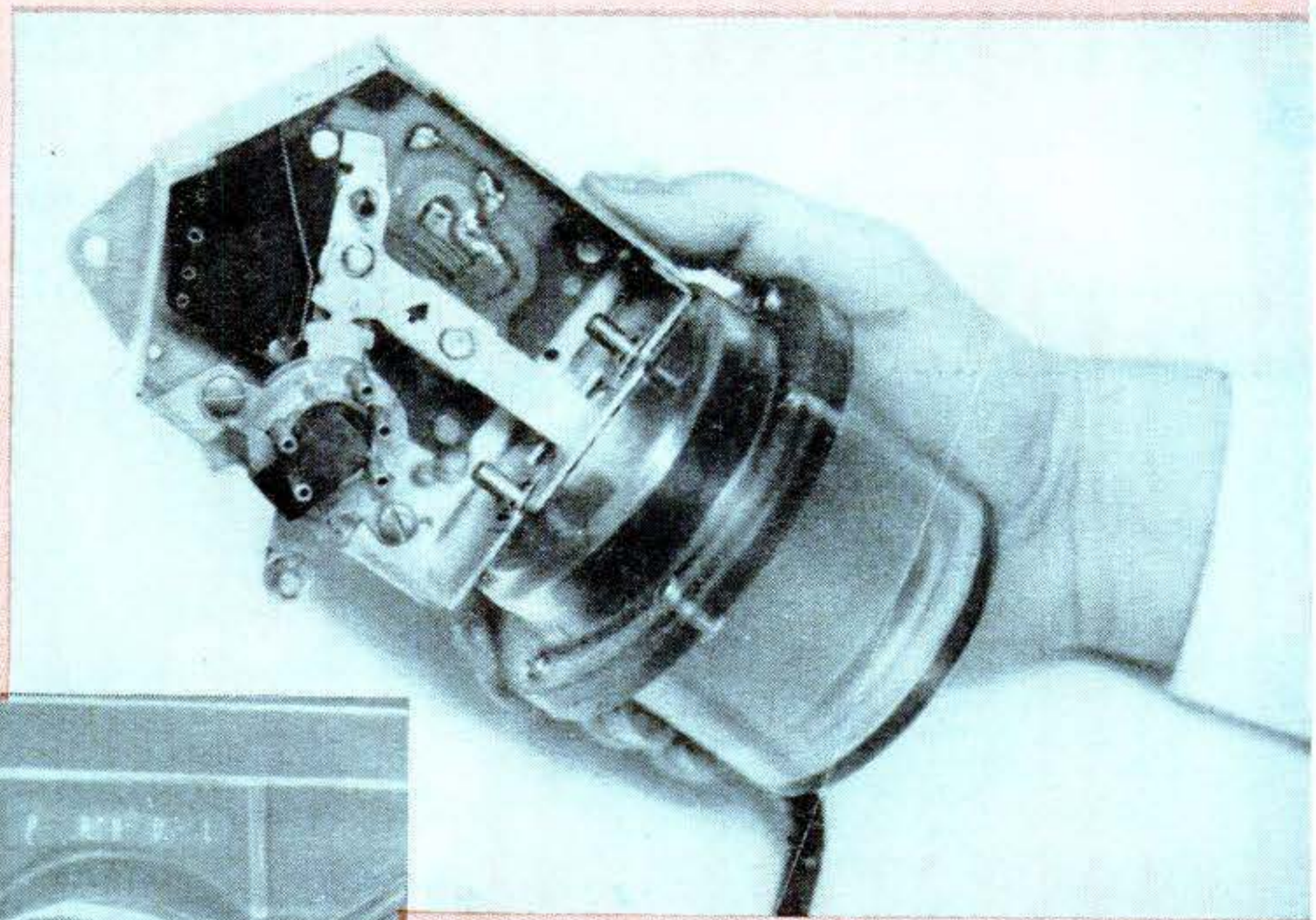
"Comfort Control" mixes warm and cool air



Sensors or "thermistors" (above) take temperature of outside air, of car's interior, of discharge air from air conditioner-heater, and of sun load.



Voltage readings from sensors are consolidated (above), amplified, and fed into a transducer—a device for changing the character of energy. A wire inside it changes length microscopically in response to changing voltage. This operates a needle valve in a vacuum line emptied of air by the engine manifold. The degree of vacuum determines the position of a piston in a power servo (right). This unit positions a valve that determines mix of warm and cool air and its delivery—by air-conditioner or heater outlets.



Single control of system is on instrument panel (left). Sensors dictate not only air temperature but volume as well at discharge outlets. Solenoids keyed to printed circuit govern blower speed, air volume.

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'64 Cadillac Makes Its Own Weather

Some styling changes, a bigger engine, and a new drive for more zip in the passing ranges also make news in this luxury car

Styling changes include new grille, lower tail fins.

ONE day last June, Dan Adams, Cadillac's assistant chief engineer, fired up a test automobile on the streets of Denver, then moved a knob on his instrument panel until an arrow on it pointed at 72. That meant degrees of temperature.

Beside Adams was a fellow engineer. The day was bright, the outside air at 85 degrees. In a matter of minutes, with the windows rolled up, a thermometer in the car read exactly what Adams had asked for—72 degrees.

They started driving west. An hour and a half later they were in the middle of a snowstorm in the Rockies' Loveland Pass. The outside temperature had dropped 50 degrees to just above freezing. But the thermometer stayed right where it had been at the start, 72 degrees.

Last month, when Cadillac announced its 1964 models, a dial-your-weather system, called Comfort Control, was a prominent option. Comfort Control had been a long time in incubation. Cadillac started experimenting with dial-your-weather five years ago. The goal was complete freedom from adjustment of the heater and air-conditioner. When, last year, the engineers combined the heating-cooling systems, they were well on their way.

Giving Nature a hand. Comfort Control is based on the premise that the human body is the world's worst thermostat. It reacts slowly to small changes in temperature. The motorist, fiddling with his heater or air-conditioning controls, may overadjust, because he's let car temperature get way out of the comfort zone.

Cadillac uses electric sensors to "read"

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all car conditions affecting comfort. The result is the world's first wholly automatic inside-weather system for cars, or, for that matter, for anything else.

For an explanation of how Comfort Control works, see diagram on page 66.

Cadillac has other things for '64. In only its third boost in engine displacement in 14 years, the company has added 39 cubic inches for a total of 429. The bigger engine is combined in some of the new Cadillacs—about three out of every five coming off the assembly line—with a new transmission called the Turbo Hydra-Matic. And this is the first basic change in transmissions for Cadillac since 1940.

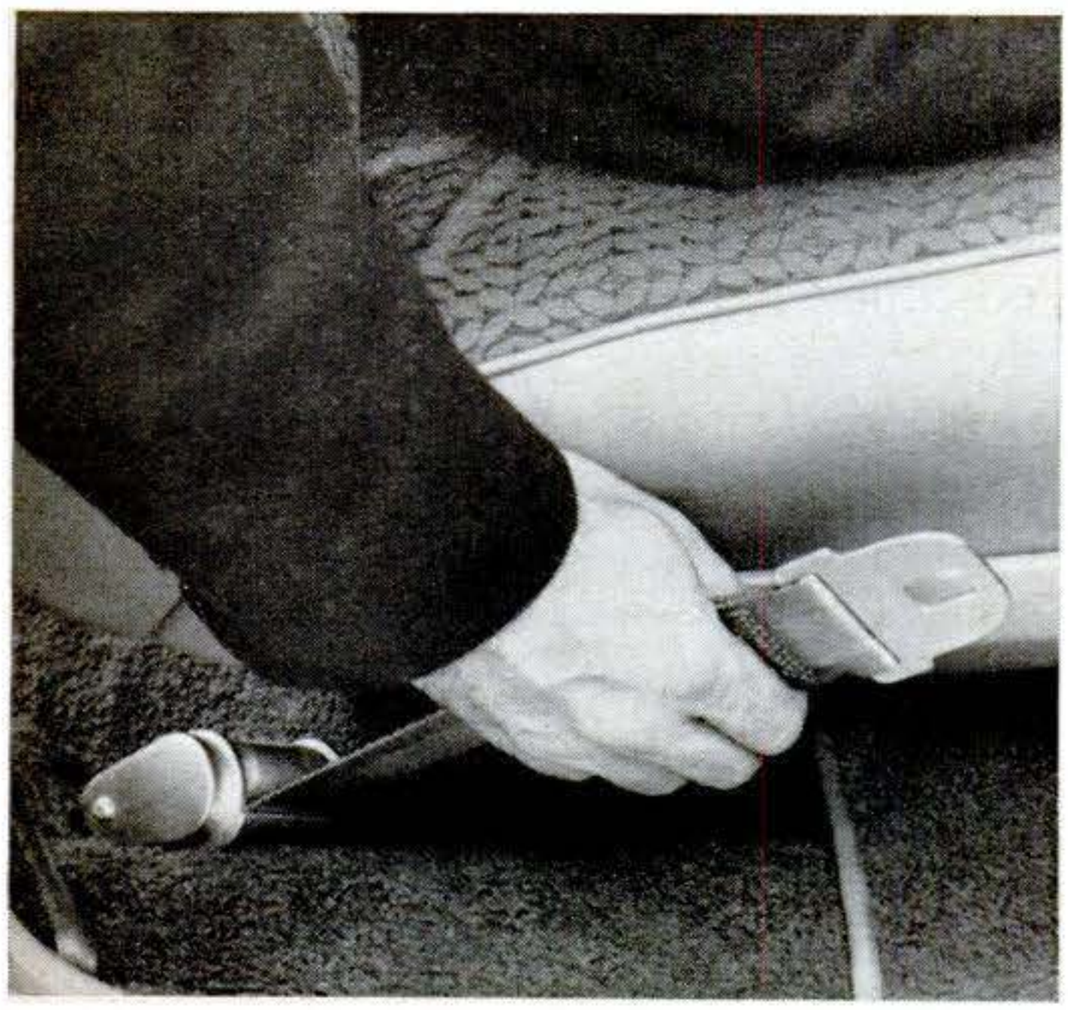
Electric eye for automatic headlight dimmer is moved from dash to tip of front fender. Horsepower is upped from 325 to 340. Fifteen years ago Cadillac boasted a whopping 160 hp.

Zip and economy. In a car weighing almost 4,800 pounds, engine and transmission provide quite an improvement in performance. Zero to 60 miles an hour has been chopped from 12 to 10.2 seconds. The car has a third more torque for passing at 50 m.p.h., twice as much at 20 m.p.h. Astonishingly, Cadillac's gas economy hasn't been affected.

A couple of gadgets should please the absentminded: an electric eye that turns on the headlights at twilight and a time-delay switch that automatically turns the headlights *off* a couple of minutes after the car has been parked for the night.

But the big thing for the new model year is that Comfort Control. Any bragging that Cadillac does about it is characteristically conservative. "The inside temperature may vary plus or minus a degree or so from the setting," says Dan Adams with an engineer's preciseness.

I say your home thermostat should be so good!—*Devon Francis.*



Seat belt ends have a spring-loaded retracter. Tiltable steering wheel, introduced last year, now has seven instead of six positions. Leather seat trim is perforated for ventilation.

Cadillac's "ducks" aren't ducks

Those things that look like ducks on the famous Cadillac crest aren't. Part of the design since 1904, they are "merlettes"—birds that never existed—ancient heraldic symbols of knighthood. They are legless and beakless. Appearing in threes, and considered sacred to the Holy Trinity, they were granted by the School of Heralds to knights for valiant conduct in the Crusades.

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World's Fair ride proved on test track

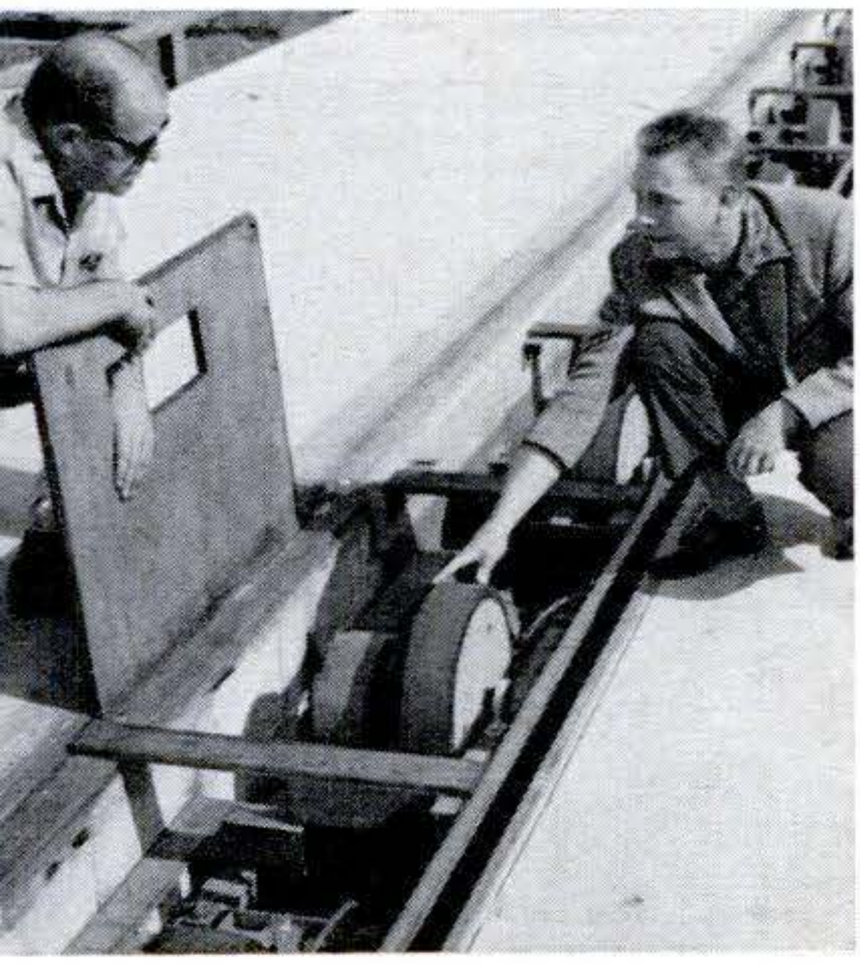
Riders get pretaste of fun on test track. Single control starts drive wheels turning. Set in track, spaced four feet apart, three drive wheels are always in contact with platen beneath each car to keep it moving at two to four m.p.h. If power fails, brake locks automatically.

An endless parade of new convertibles will carry visitors through a major attraction in the Ford Pavilion at the New York World's Fair, opening next April.

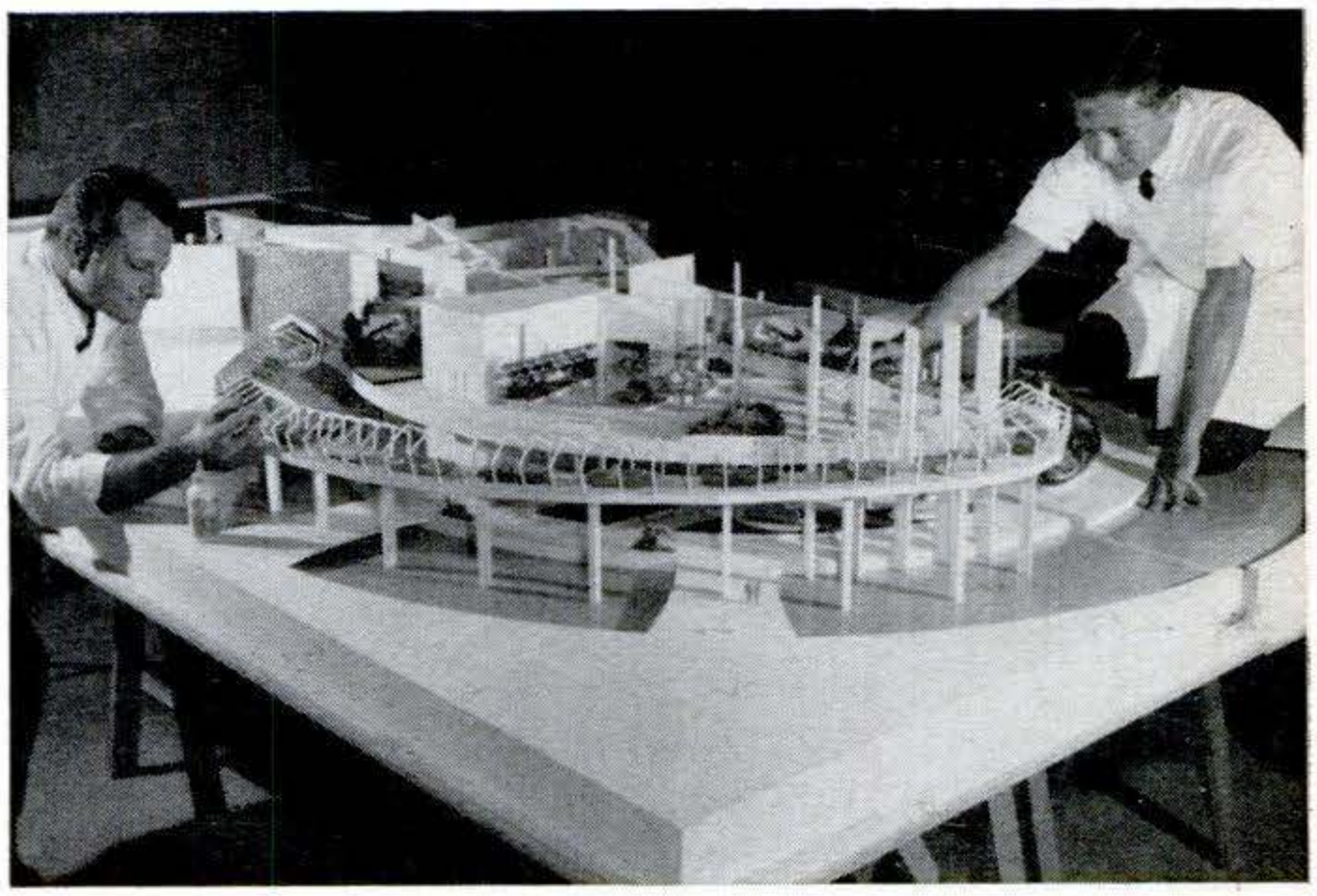
The cars—a mixture of Ford brands—won't have engines or drivers. Instead, they'll move continuously at two to four m.p.h. on rubber-treaded, electric-powered wheels set in two half-mile tracks. On the ride, passengers will pass through a Walt Disney fantasy of animated figures and stereophonic sound, then go through a transparent air-conditioned tube overlooking the grounds from two stories up.

For more than a year, a small version of the Magic Skyway has undergone trials for safety and reliability in Glendale, Calif. The system was designed by Disney's WED Enterprises, which also created the animated attraction for the pavilion.

The test track is only 500 feet long, but it duplicates the curves and the 10-percent grades of the full-length twin tracks now being built in New York.



Drive wheels are powered by individual motors—one hp. on grades, ½ hp. on level. Gears vary speed of wheels.



Scale model of Ford's Magic Skyway shows (in foreground) transparent tubular roadway two stories above ground. Rubberized moving sidewalk paces cars at loading and unloading platforms for passengers taking nine-minute nonstop tour of pavilion.

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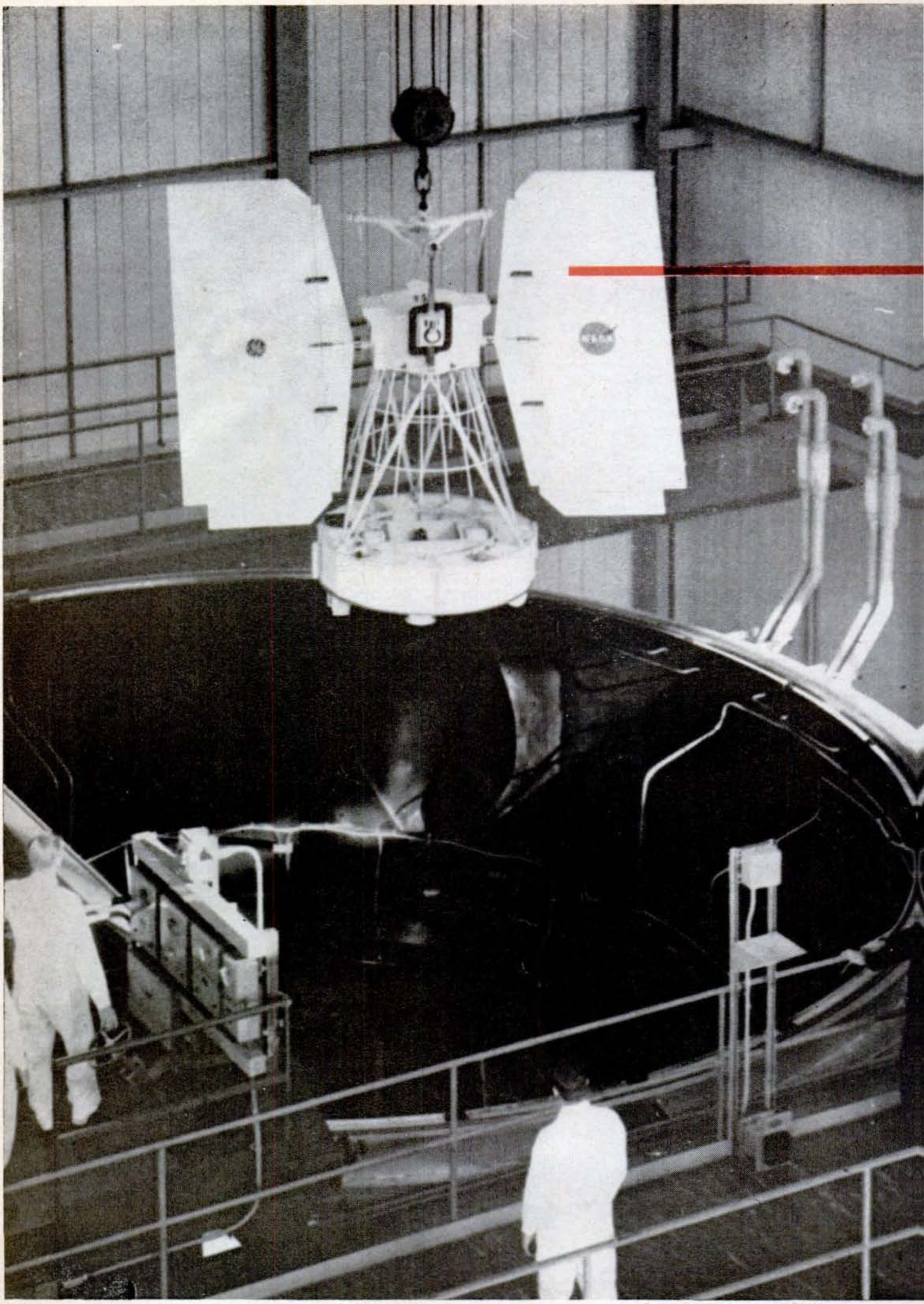

Nimbus is lowered into vacuum tank for preflight testing under simulated space conditions.

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The Weather Eye That Never Blinks

By Wesley S. Griswold

From 500 miles up, the Nimbus satellite will photograph every square foot of the earth's cloud cover every 24 hours

By Wesley S. Griswold

BEFORE long you'll be able to look up at the sky every day at noon—no matter where you are on earth—and know there's a weather satellite overhead. You won't be able to see it, of course, but Nimbus will be up there, watching the movement of the clouds and reporting to weather stations below.

There's already a flock of Tiros weather satellites in orbit, but it will take just one Nimbus to be directly over every spot on earth at close to twelve o'clock, local time. That's because of its ingeniously arranged polar orbit, fixed in space so as to take advantage of the earth's rotation (see sketch).

Nimbus, the Latin word for cloud, is the name of the next U.S. series of weather satellites. The first Nimbus launch is scheduled for December or early next year. These will be more sophisticated birds than the Tiros series (that name, incidentally, stands for Television Infra-Red Observation Satellite). However, the Tiros series has been so successful that Tiros satellites will continue to be orbited even after Nimbus is in operation.

Our space engineers are justifiably proud of the record established by Tiros,

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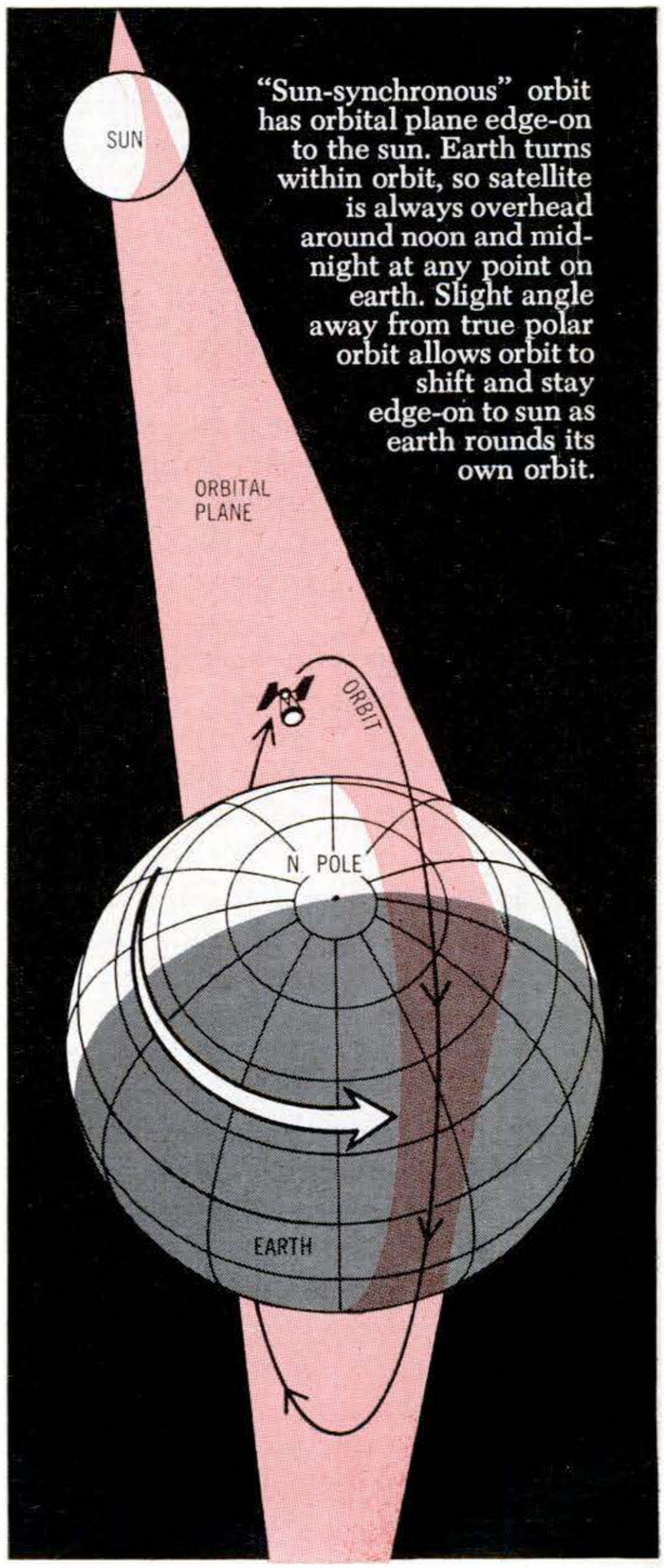

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as I learned when I visited a ground-control station to see how weather pictures are retrieved from a satellite. (Seven of the Tiros series had been placed in orbit when this article went to press, and an eighth was scheduled to be launched.) Since April 1, 1960, when the first Tiros was sent up, weather satellites have delivered over 200,000 usable photos of cloud and ice formations.

These pictures, made with surprisingly small cameras from an average height of 400 miles, have improved weather forecasts everywhere. The satellites have sounded the alarm at the approach of the world's most dangerous storms. Last year, they detected Hurricane Esther two days before anything else did. Their panoramic views of weather in the making have helped decide when astronauts were to be lofted. They have also aided in timing the launches of other satellites, and in determining when supply ships should visit an Antarctic expedition. They've even impressed the Russians, who have signed a treaty to share in their benefits.

Keeping its eyes on earth. If Tiros has been so successful, why is the Nimbus series necessary? For one thing, the cameras aboard Tiros don't always point at the earth. During part of each orbit, they see us; the rest of the time they're staring into space. Nimbus, on the other hand, will be "earth-oriented." Gas jets and flywheels will turn it to keep the cameras always pointed toward the center of the earth. For this purpose, sensors aboard will keep telling its control circuits where the earth is. Other sensors will locate the sun, so that the paddles carrying solar cells can be kept aimed in that direction.

Nimbus will also have a better orbit than Tiros. Crossing the equator at an angle of about 80 degrees, it will be essentially a polar orbit. Tiros satellites have orbits crossing the equator at shallower angles, up to 58 degrees, giving poor coverage of the high latitudes. Nimbus will be able to take pictures of every square foot of our cloud cover every day, with its cameras pointed straight down.

Picture-taking will even continue "at night" (when the satellite is in the earth's shadow). Nimbus will carry a high-resolution radiometer to take infrared pictures of clouds by sensing their heat.

For daylight cloud pictures, two sets of three TV cameras will take three-frame composite shots of the earth's surface. From 500 miles up, each strip will cover an area 1,450 miles across (east-west) and 450 miles deep (north-south). As the satellite moves from pole to pole, 32 of these pictures will be taken during each half-orbit. Magnetic tape recorders aboard are capable of storing the pictures taken during two complete orbits, for readout to ground stations. All six cameras together will take a total of 1,300 cloud pictures every day.

The APT system. The satellite will also carry another TV-camera system, aptly called APT—for Automatic Picture-Taking system. This uses a single TV camera, which shoots an area of the earth's surface 1,000 miles square. Every three minutes this camera will automatically take a picture and store it in an electrically charged layer on the face of its vidicon tube. The picture will then be scanned very slowly—taking 200 seconds for a complete readout—and transmitted to earth.

The slow readout means that relatively simple receiving equipment can pick up the signal, and that it can be converted into a picture by a facsimile printer instead of being photographed off a television tube. This adds up to a small, fairly inexpensive ground station —costing only about $30,000. Thus, satellite weather stations can be spotted all over the globe (even the poorest nations can afford them), spreading the benefits of the weather satellites more widely. An APT ground station will be set up at

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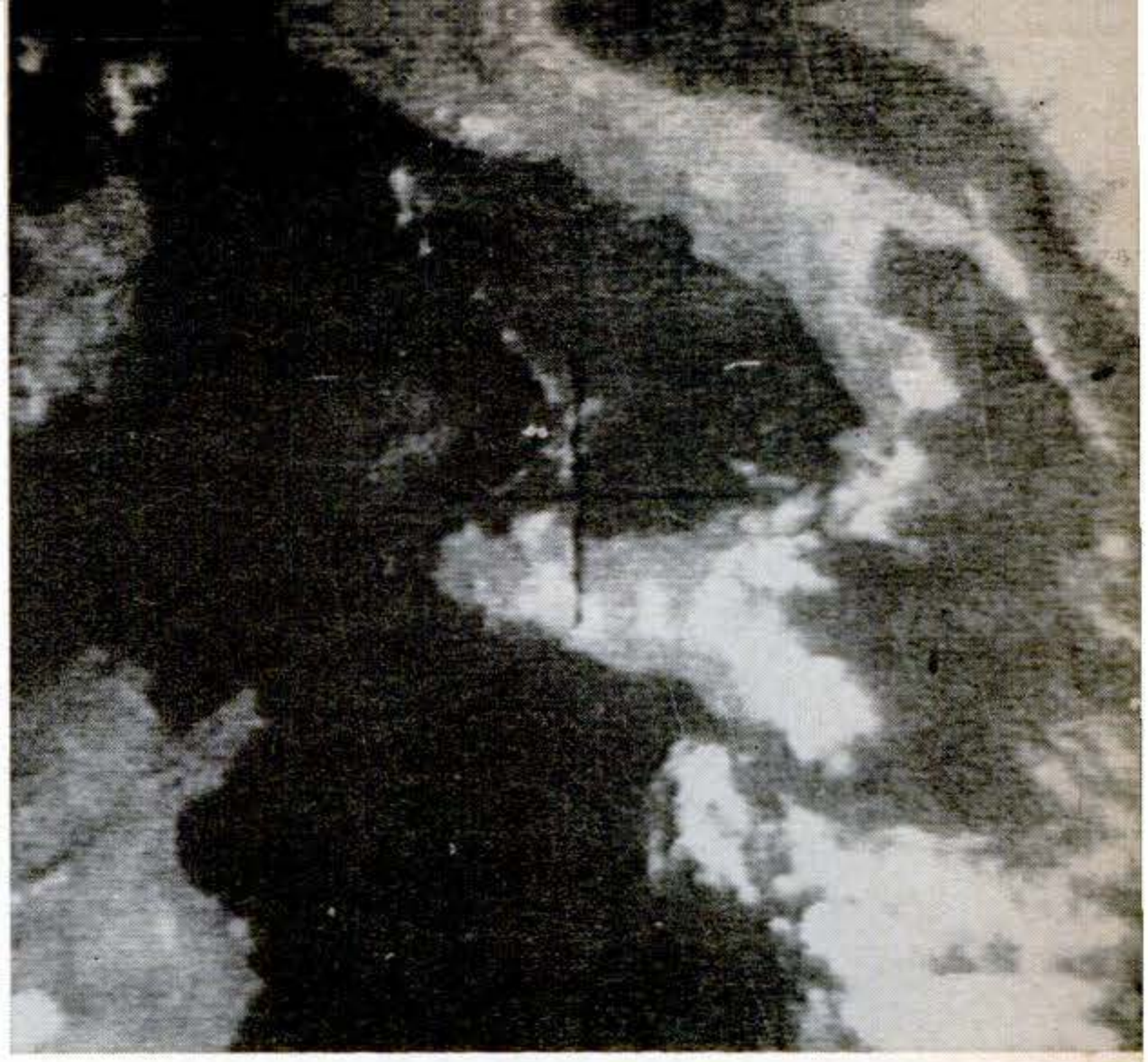
the New York World's Fair next year.

Since Nimbus will be overhead at the same time every day—around noon—an APT ground station doesn't need computers and complicated tracking antennas to locate the satellite. Getting pictures of the local cloud cover isn't much more complicated than pointing the antenna straight up and turning the facsimile printer on. Pictures of adjacent 1,000-mile-square areas can also be received, during orbits earlier and later than the noon orbit.

For the global weather picture, however, we'll still depend on complex ground stations that signal the satellite to release the pictures it has taken during complete orbits and stored on tape. For Nimbus, this photo-gathering system will be substantially the same as that now used with Tiros. The present system involves two Command and Data Acquisition stations operated by the National Aeronautics and Space Administration—one at Wallops Island, Va., and the other at Point Mugu, Calif., with its antenna 70 miles southwest on San Nicolas Island. To see how it works, I went to Point Mugu one evening last spring.

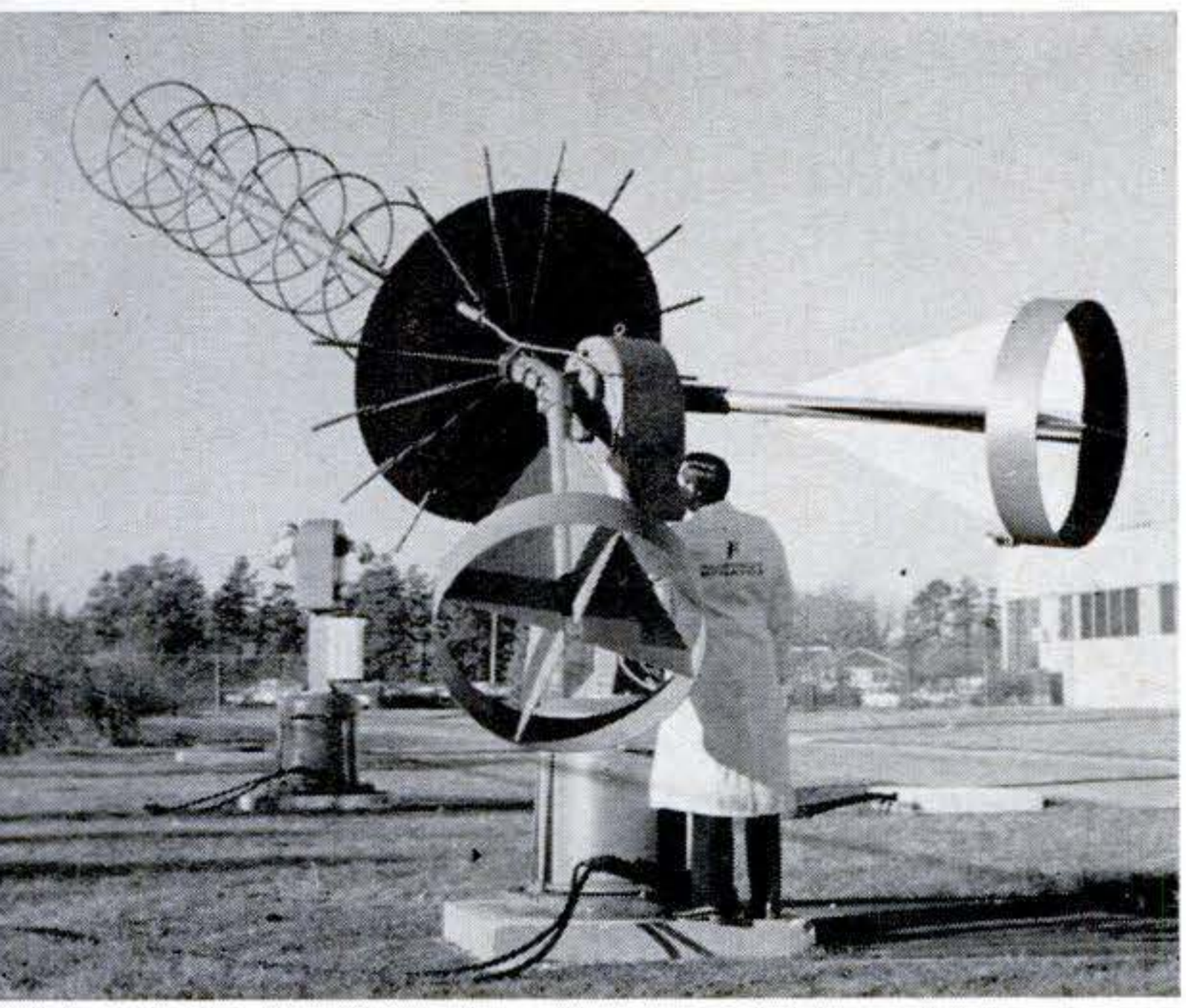


A clear day over the Mediterranean, shot by a Tiros weather satellite. As on a map, Italy seems to be kicking Sicily toward North Africa. White patches at lower right are clouds.

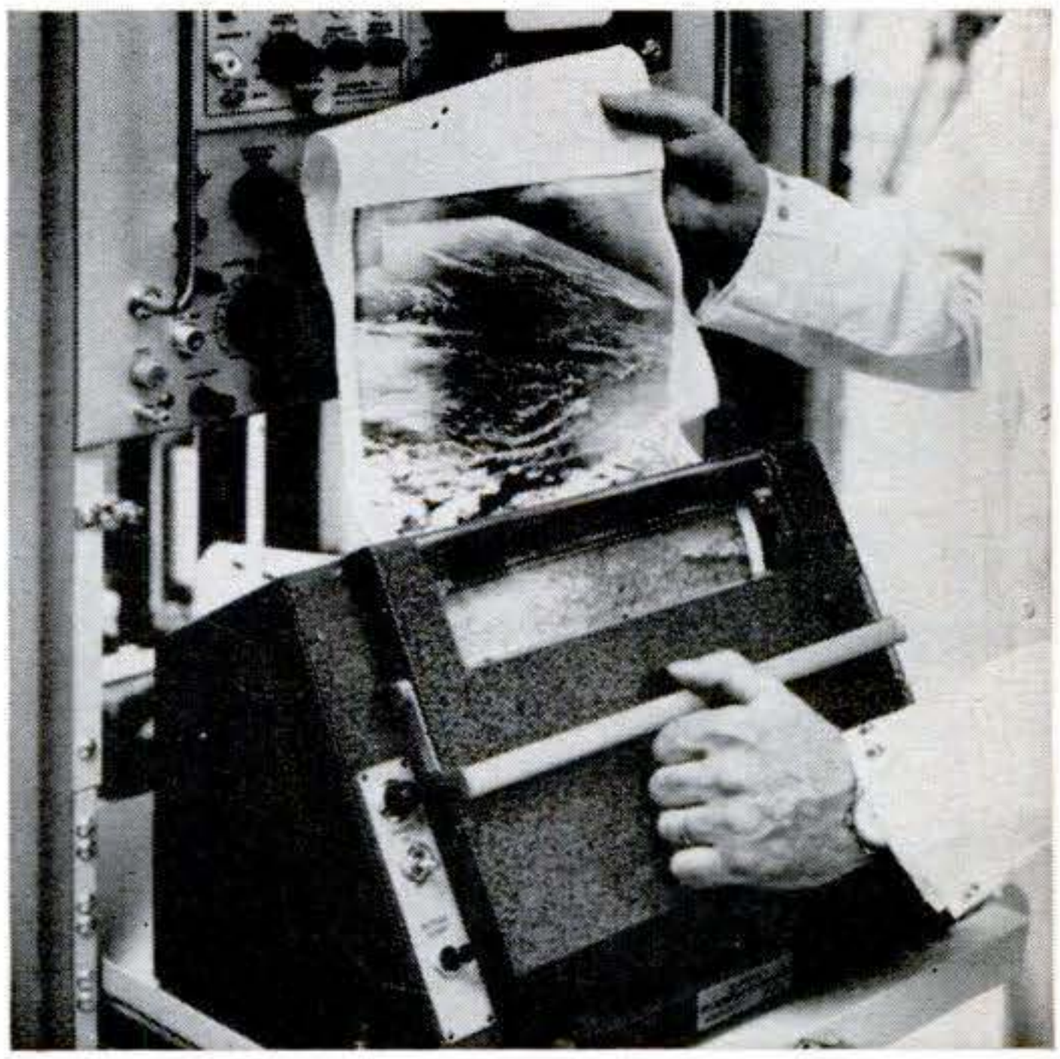
Waiting for Tiros. The sky was bright with stars. My night visit had been timed to begin a few minutes before Tiros VI made its invisible appearance over the horizon.

As I walked into the Pacific Missile Range's Weather Center, I heard a voice from a loudspeaker call out, "Two minutes, 30 seconds till antenna starts."

[Continued on page 200]



Compact weather station costing only $30,000 can be set up anywhere to receive cloud pictures from Nimbus. Simple helical antenna (left) doesn't require extremely precise aiming.



Photos of 1,000-mile-square areas covering vicinity of weather station are turned out rapidly by facsimile printer (right) as satellite passes overhead on its daily rounds.

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They Take All the Fun

Safety engineer Alonso Dickinson atop Verrazano Bridge, at New York's harbor entrance.
PHOTO BY BILL MORRIS

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Out of Getting Killed!

By Norman Carlisle

TIRED from fighting the wind whipping through the framework of a new skyscraper going up in New York, engineer Alonso Dickinson leaned against a wooden barricade surrounding the hoist shaft. A sudden chill ran through him. The thing had moved! Suppose a worker happened to hit against that barricade with unusual force? Wouldn't he go plunging down the open shaft to the street 52 stories below?

Being the kind of engineer he was, Dickinson raised a ruckus. Sure, such barricades were in common use, and it wasn't likely that seasoned steel workers, accustomed to walking around on naked steel with no protection at all, would ever need much support. Nevertheless, Dickinson designed, and had installed, a threaded pipe railing.

A couple of days after it was put up, a worker was hoisting material when a sling gave way. The gear dropped on him. He slammed into the railing, and hung on until he could be helped back to safety. With the old shaky barrier, he'd have plunged to his death.

Beating death to the draw is the business of Alonso Dickinson, and of some 300 other hawk-eyes in hard hats, his colleagues in a remarkable and little-known profession. They're the safety engineers employed by companies that write insurance for contractors and builders. All over the world, on buildings, tunnels, bridges, dams, airports or pipelines built by American contractors, these roving danger detectives are on the job. They join sandhogs in tunnels, clamber up high steel with steelworkers, and prowl highways in the jungle, airfields in the Arctic, and pipelines in searing deserts. Countless construction workers owe their lives to their vigilance.

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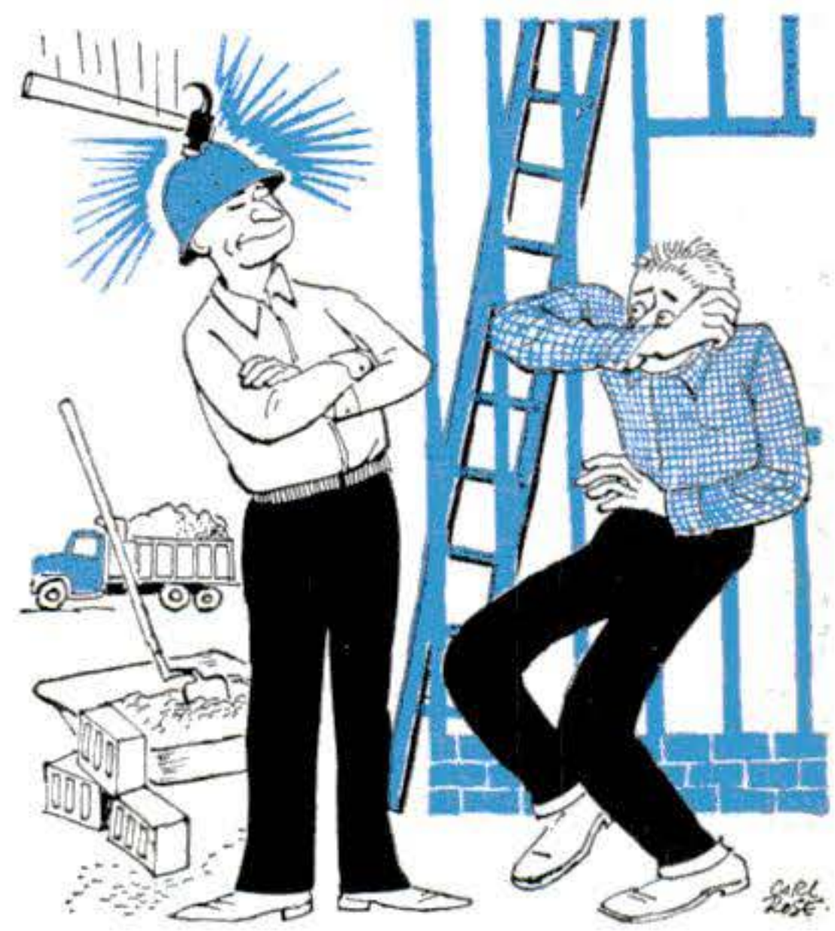
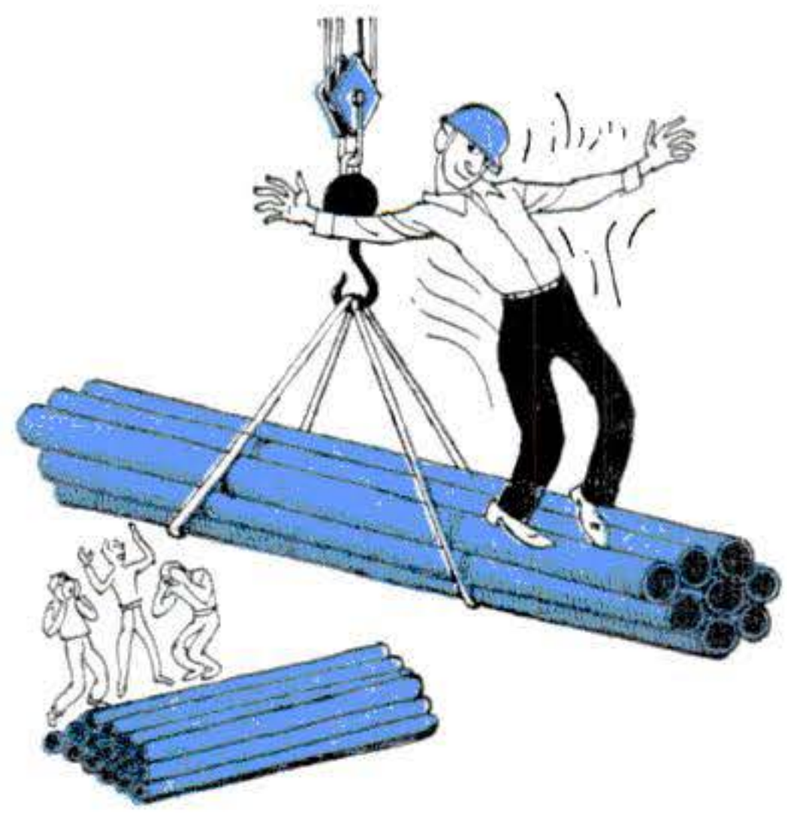
While the boss thought it over, a two-ton rock tumbled down, smashing an unoccupied truck.



He would set up a little demonstration—like having a hammer dropped on his head.



He went through a realistic silent-movie routine of pretending to lose his balance.

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The circle of danger. Take the time Ralph Spencer, a safety engineer working out of Wausau, Wis., went to case a dam-construction project in Montana. Things looked all right until Spencer asked about a stiff-leg boom that towered above the site.

"What're you using that for?"

The contractor told him that he planned to lift two big steel gates into place with it. Spencer took a look at the gates, measured the cables on the boom, did some figuring about the angle of lift, and announced, "You can't do it." The gates weighed 25 tons; any way he calculated it, the boom wouldn't support anything over 20 tons. And men would be working right under it as the gate was lifted.

"Suppose that thing breaks?"

The contractor shrugged. "It's all we've got to use. Anyway, it's plenty strong."

The argument went on until Spencer got hot under the collar. Finally, he said, "Well, let's test it."

He took a stick and drew a huge circle on the ground. "Any man standing inside that is risking his life," he announced.

The area was empty as the gate began to rise. It went up smoothly at first. Then there was a loud snapping sound, the boom crumpled, and the gate plunged to the ground. Inside the circle there was a mass of wreckage, but not one piece of debris had gone outside it.

Most of the time it's not so simple as drawing a circle on the ground. The safety men, most of them civil or mechanical engineers, not only spot dangers but devise ways to eliminate them. On-the-job menaces are by no means standardized, as Dick Burbank, from Hartford, found out when he shinnied up the wall of a quarry in Indiana. Truckers driving in to get loads of rock for a road embankment made wisecracks about the human fly who was risking his neck up there on the rocks.

When he came down, Burbank told the superintendent the drivers wouldn't think it was so funny if what he thought might happen actually did. There were a lot of loose rocks up there—big babies—and the trucks were driving right under them.

The super wasn't moved. "Gotta drive in there," he said.

Burbank agreed there was no way to avoid that. But, he added, he'd figured out a way to lick the problem: build a timber-and-rock structure that would roof over the danger zone. While the management was thinking it over, a two-ton rock came tumbling down, smashing an unoccupied truck.

"I swear I didn't arrange that," Burbank explains with a grin, "but it sure came in handy."

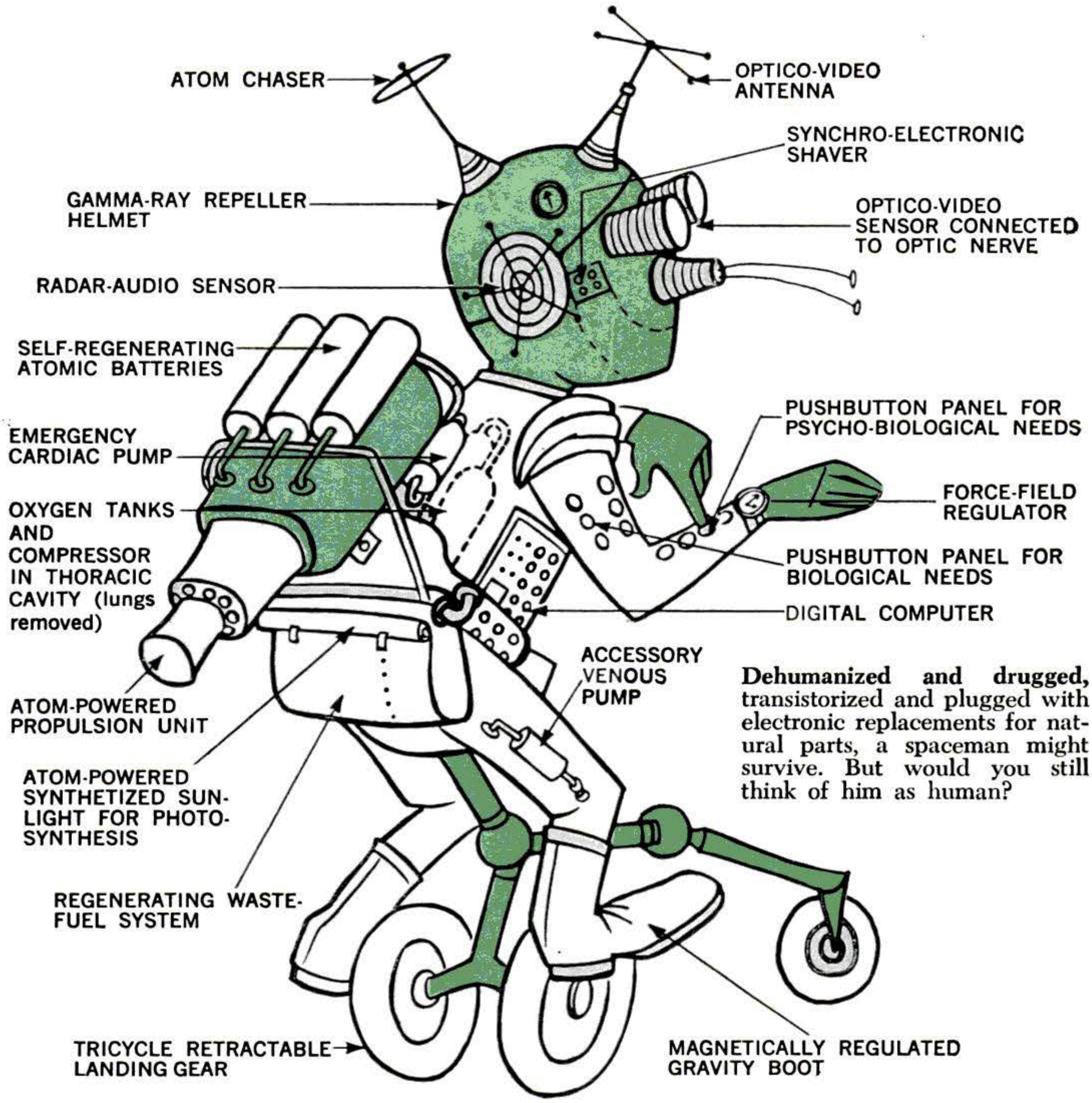
The warriors showed off by sticking their spears into the empty sockets.

The enemy: carelessness. Safety engineers all tell you that their biggest enemy is carelessness. There was, for example, the mysterious Boston water-supply tunnel explosion, in which five men were killed. Harold Gurney rushed to the scene to try to find out what had set off the dynamite. Static electricity? Metal touching metal to create a spark?

Gurney began a vigil when the new, and jittery, crew started work. As they rolled the wooden dynamite cart down a wooden track, he trotted behind. He hovered over the men as they wired their charges, all the while painfully conscious that if the same thing happened that had set off the deadly blast, they'd be picking up pieces of Gurney, as well as the rest of the crew. Three blasts were set off without mishap.

[*Continued on page 202*]

Must Tomorrow's Man Look Like This?



Dehumanized and drugged, transistorized and plugged with electronic replacements for natural parts, a spaceman might survive. But would you still think of him as human?

By Toby Freedman, M.D., and Gerald S. Lindner, M.D.

No electronic plug-ins needed, say these two doctors. Man's own capacity for adaptation, with help from science, can fit him for new ways of life

THE design of vehicles is one of the oldest and noblest arts of mankind. Look at a model of a prehistoric Polynesian canoe. It's as hydrodynamically elegant and functionally beautiful as the X-15. The wheel, the ski, the kayak, the sports car—pure

From a speech at annual meeting of American Rocket Society. The authors are researchers with North American Aviation.

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Roly-poly shape of the Eskimo exposes less of him to the cold. (A sphere's surface is the minimum area for a given volume.) Many Eskimos also have extra layers of insulating fat.

Short-trunked, long-limbed African Latuka tribesmen are prime examples of tropical efficiency. A lot of surface area for evaporation helps their bodies to dissipate heat faster.

geometry in motion. No doubt the engineers of these perfect and symmetrical structures beat their heads against the wall when told they had to squeeze in a passenger. One of the earliest recorded utterances in Samoan is the comment of a legendary canoe builder: "I'll be damned if I make the thwart four inches wider just to fit somebody's big fat ——" (the inscription becomes illegible at this point).

This attitude has persisted. Anyone who has tried to get out of a bucket seat while parked on a hill knows that automobile designers hate people. And airframe and spacecraft engineers obviously feel that the art would be 10 years ahead if there were some way to eliminate the pilot and human-factors personnel.

In favor of men. Now it is natural for us, as physicians, to be prejudiced in

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Tall and hardy, desert nomads like the Tuaregs of the Sahara survive extremes of heat and cold as well as drought, wind, and sandstorms. Their diet is rich in camel's milk, millet, and barley.

Barrel-chested, the Peruvians play soccer at 14,900 feet. You'd be winded; they make up for oxygen loss with bigger lungs, better breathing, high red-blood-cell count, less body fat.

favor of human beings. But we have to admit there must be some reason for the persistence of the opposite point of view —that the only component that spoils the design is the human.

Why is this? The answer is simple. Every other component from nuts and bolts to rocket fuel comes in a wide variety of sizes, shapes, strengths, physical and chemical properties. The human sub-system is unfortunately manufactured in only one basic model. And the engineer is stuck with it. He can ask for a hex nut or a six-way switch, but a six-handed human is not in stock.

These are intolerable limitations. Yet up to this decade only two approaches have been used to cope with them.

The Spartan approach. We reluctantly accept the need for a pilot and provide him with a minimum life-protective system. The pilot of the X-15 is encased

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in an aluminized space suit in an artificial oxygen-nitrogen atmosphere and strapped into an ejection seat which is his only escape-and-survival mechanism. Nobody asks him if he's comfortable or if he'd like to scratch the back of his neck.

The other extreme is the all-out engineering approach. The engineering department asks the human-factors group to supply a schedule of numbers, specifying the weird dimensions and feeble mechanical properties of humans. The engineers then demonstrate their virtuosity by providing what we've come to call a shirt-sleeve environment. They say, "Give us your miserable requirements for those fragile, feeble creatures with their almost negligible strength/weight ratio. Integral calculus can overcome even this handicap. We'll make a capsule with all the comforts of home."

Up till now this has been possible, and engineering achievements have been fantastic. Jet flight is accomplished under conditions of far greater comfort than picking up your luggage at the airport. But space travel is different. Designers may no longer be able to give the traveler a replica of his earth environment. Solar-flare-radiation protection has been estimated at hundreds of pounds of lead shielding per man. This alone takes us into a new category. The medical group finds it embarrassing to keep asking for more lead every time a new radiation hazard is discovered.

Changing the model. We are forced to begin thinking about attacking the problem from the other end. Maybe we could give the astronaut a pill that would do the trick, and throw away the extra lead. In other words, instead of modifying the ship, modify the man. Simple as it sounds, a proposal like this rouses tremendous opposition. We have inherited a tradition of the natural man, the perfect physical specimen impossible to improve. Medicine has in the past confined itself to restoring the patient to this natural state and left it to cults and quacks to offer programs for developing superhuman powers.

Yet, if we look at the evidence, all over the world there are people with what are literally superhuman abilities. Tibetan lamas can maintain normal skin temperature in subzero cold. Yogis buried alive manage on a fraction of normal oxygen consumption. Eskimos thrive on a high-fat diet that would give us all coronaries. Peruvian Indians do heavy labor at altitudes where you and I couldn't breathe. These remarkable adaptations have been accomplished without the benefit of science.

Tooling up. Now science, for the first time, has taken the trouble to investigate these phenomena experimentally. Trances and suspended animation, long in the same boat as the Indian rope trick, are now legitimate objects of research under the names of hypnosis and hypothermic hibernation. Research on body mechanisms—cerebrospinal-fluid control and blood-content detection in the brain—will almost certainly lead to an understanding and control of acclimitization. Then we can go to the engineers and say, "Throw away half those oxygen cylinders: Our astronaut breathes like a Peruvian."

Man can be improved. What's more, people have been working on it for centuries. The only difference now is that science can take a hand and speed up the process.

The problems of space travel will supply the initial impetus, and early improvements in man will be mainly designed for the astronaut. The adverse effects of weightlessness will be overcome by drugs and physical therapy. Radiation resistance will be increased by medication, hypothermia, possibly skin ointments. Tolerance to low-oxygen partial pressure and extremes in temperature and pressure will be improved. But it is obvious that such research will benefit more than the astronaut.

The public is as interested in radiation protection as the man on his way to Mars. Today a Finnish doctor has found a way to mobilize strontium 90 and expel it from the body using parathyroid extract and pilocarpine nitrate. Tomor-

[Continued on page 188]

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Floodlights let golfers tee off after dark

Duffers and pros are now on the way to playing night golf. Like bowling alleys, baseball diamonds, tennis courts, and football fields, Tall Pines Golf Club near Philadelphia has put up lights—the first regulation course to have them. Installed on the nine-hole, 3,230-yard plush links are 121 GE 1,000-watt mercury floodlights. They provide 10 footcandles on tees and greens, five footcandles on fairways.

Amphibious-hydrofoil landing craft

With hydrofoils extended, this landing craft for Marines can skim the waves at 35 knots. Then, with hydrofoils retracted and wheels lowered, it can hit the beach and travel on land at up to 40 m.p.h. The LVHX2, shown on a trial run in San Francisco Bay, was built by the FMC Corp., San Jose, Calif. First amphibious hydrofoil of its kind, the vehicle was designed to speed the Leathernecks' assault punch.

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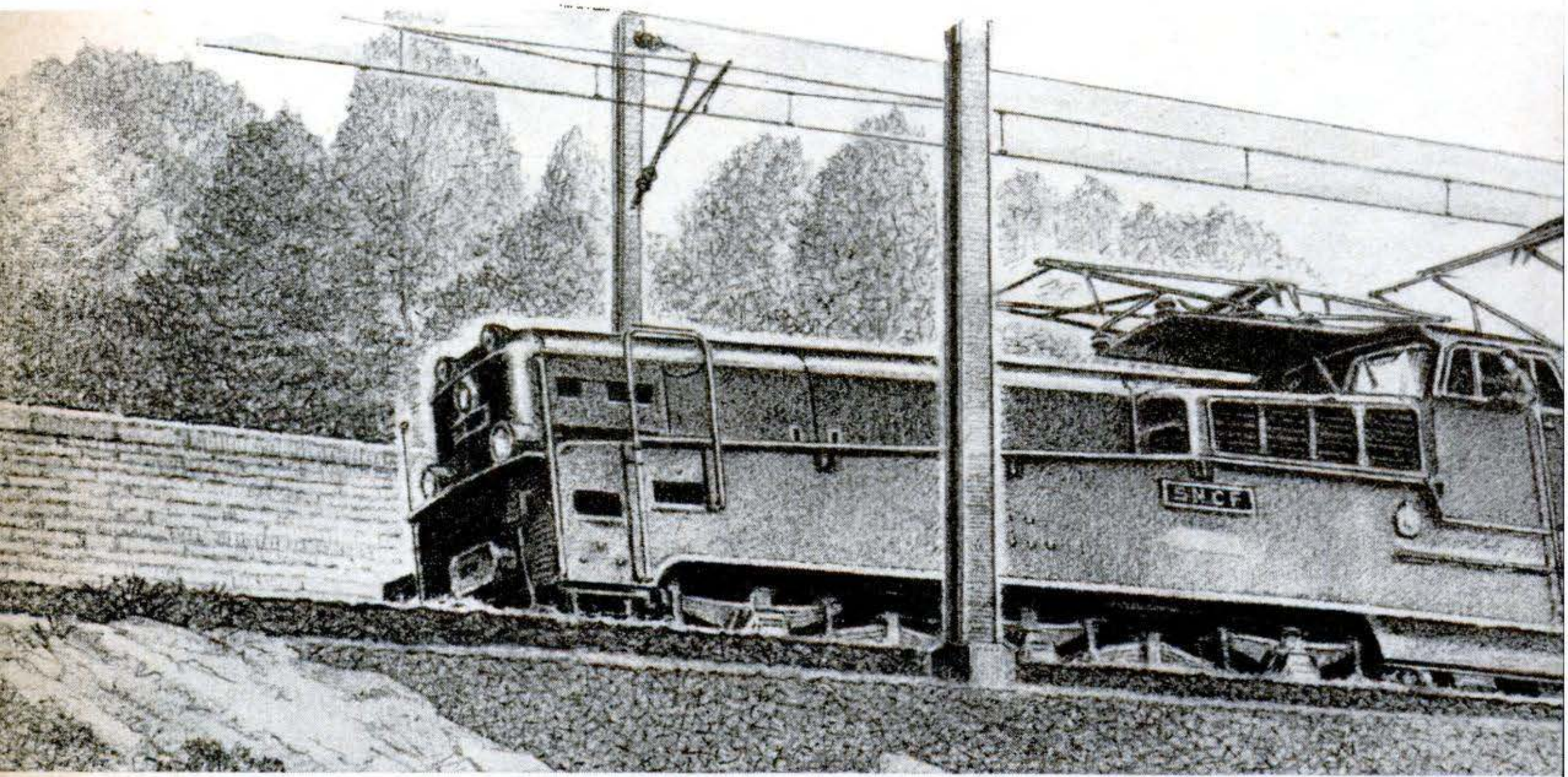
Why Can't We Run



Largely rebuilt since World War II, France's rail network is troubled by few of the problems that plague American lines

Drawings and Text by Henry B. Comstock

"IT IS a pity," said the grade-crossing watchman near Lyons, "that your railroads were not bombed as ours were during World War II. Then you Americans would know their worth, and treat them with more understanding."

I had let myself in for this blast when a guard dropped his gates in front of my car. Climbing out, I'd asked him in fractured French what train was coming.

"*C'est le Mistral,*" he told me proudly. He was pointing at a pale green blob uptrack. In seconds it zoomed into focus —a screaming electric locomotive, flashing a comet's tail of stainless-steel coaches. Small boys in backed-up Peugeots and Simcas shouted and waved their caps.

They had reason to. For this was the world's fastest rail flyer. Named for a fierce wind that howls persistently down the Rhone Valley, the Mistral clips off 318 miles of its daily run between Paris and the French Riviera averaging 80 m.p.h., including one stop. In tests, an engine of the type that whips it under the hot wires once clocked a mile in less than 18 seconds. To do it, the speed hand trembled at the 205-m.p.h. mark.

Profits follow speed. But the Mistral is more than the fastest thing on flanged wheels. It's a symbol of a wonderfully coordinated and profitable transportation setup, troubled by few of the problems that plague U.S. railroads. Consider:

- The SNCF *(Société Nationale des*

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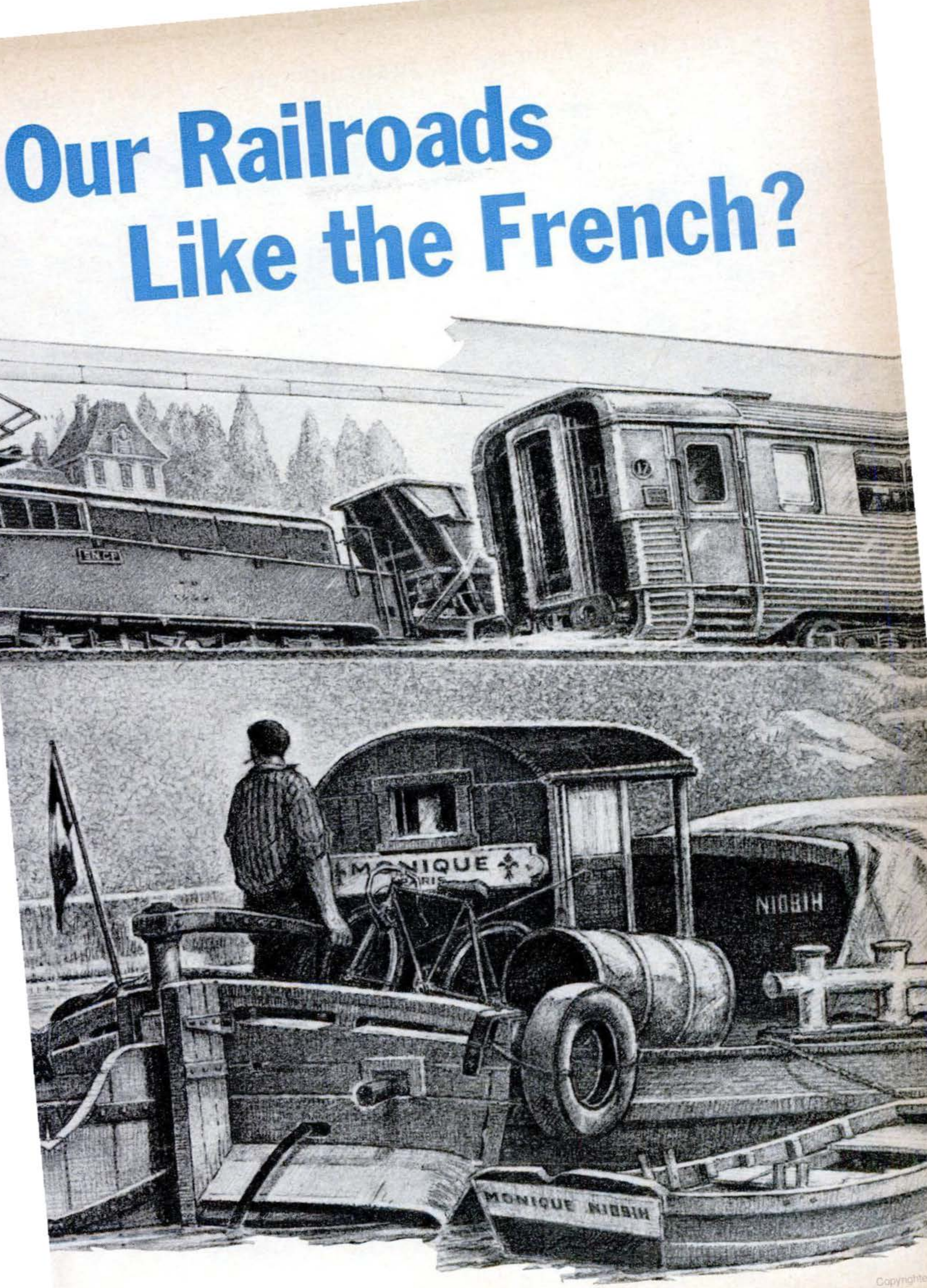
Our Railroads Like the French?



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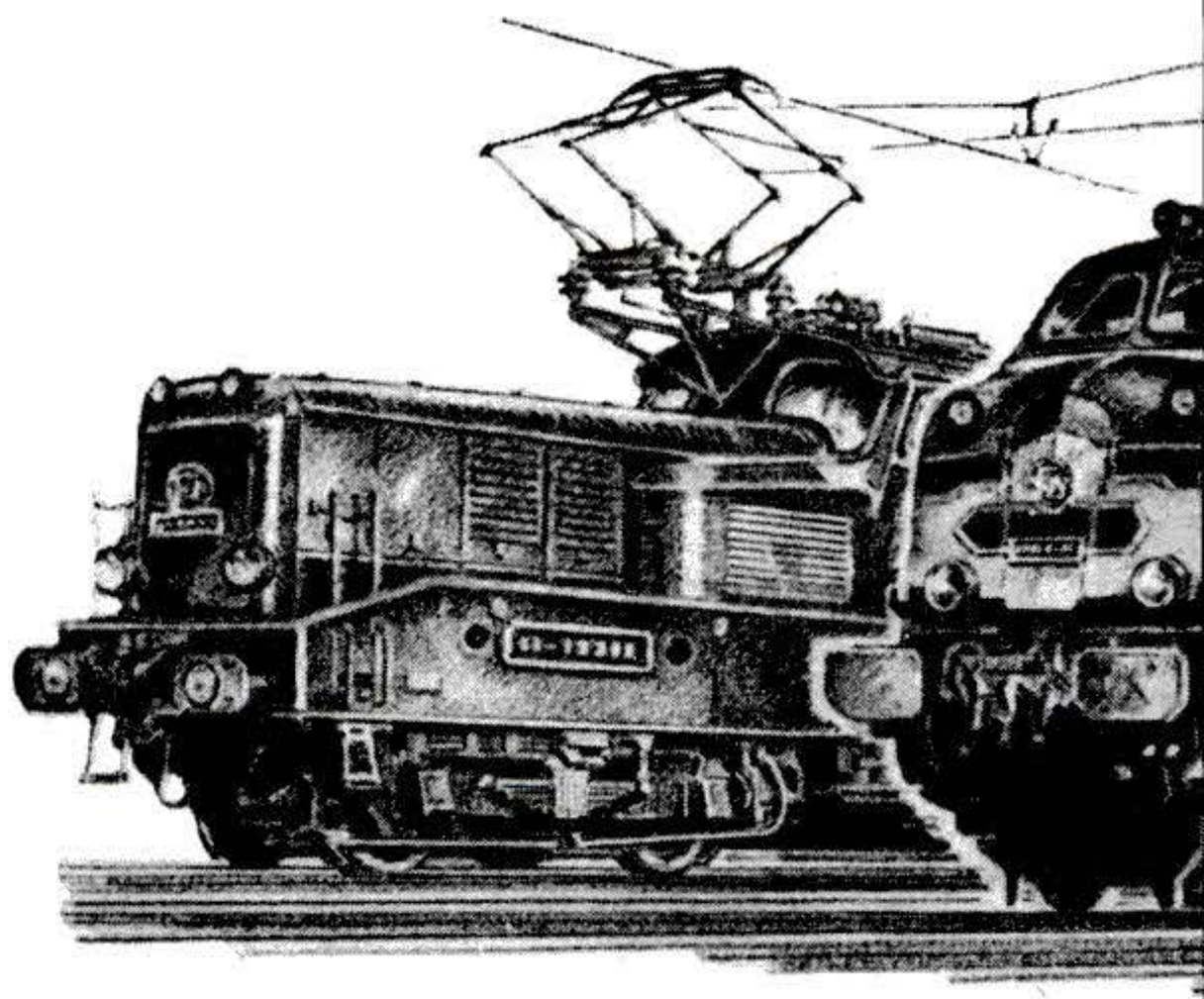
Fast trains, fine meals, first-rate service draw travelers

Speedy locomotive of type assigned to France's famed flyer Mistral racked up 273,400 miles in seven months.

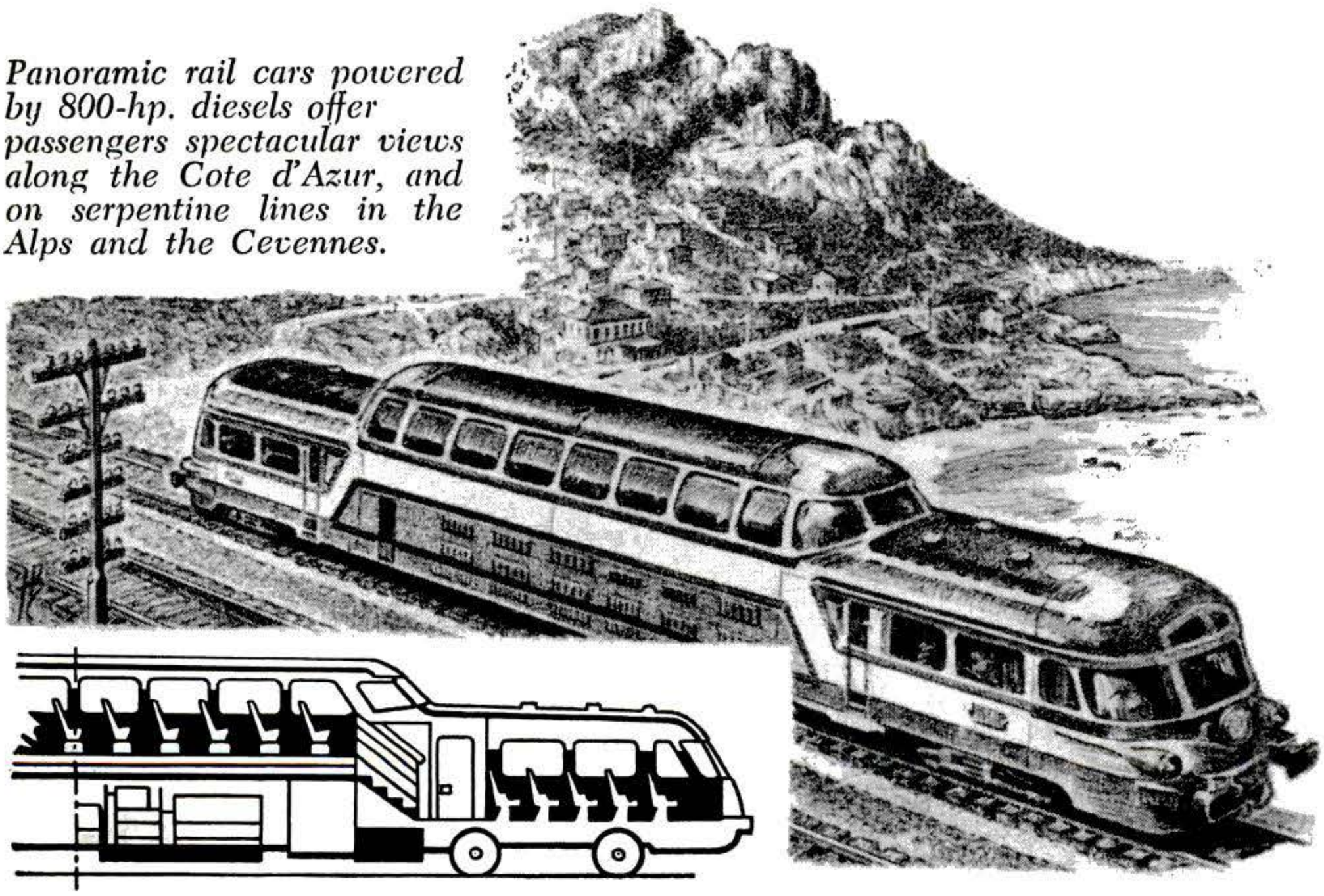


Chemins de Fer Français) has upped its passenger traffic 43 percent since 1938. Ours is down 50 percent.

• French freight trains handle 70 percent of the nation's inland tonnage. Here, it's the other way around—30 percent.

• SCNF's network of lines is practically all "sinew." The ruthless pruning job done by the Germans, Allied bombers, and the French Underground forced France to reappraise her transportation needs in 1945. Only vital routes have been rebuilt. They still add up to 26,500 miles of main lines, serving 45 million people in an area of 212,000 square miles. Coincidentally, all those figures and another—France's half-million highway miles—about match those in a

Panoramic rail cars powered by 800-hp. diesels offer passengers spectacular views along the Cote d'Azur, and on serpentine lines in the Alps and the Cevennes.



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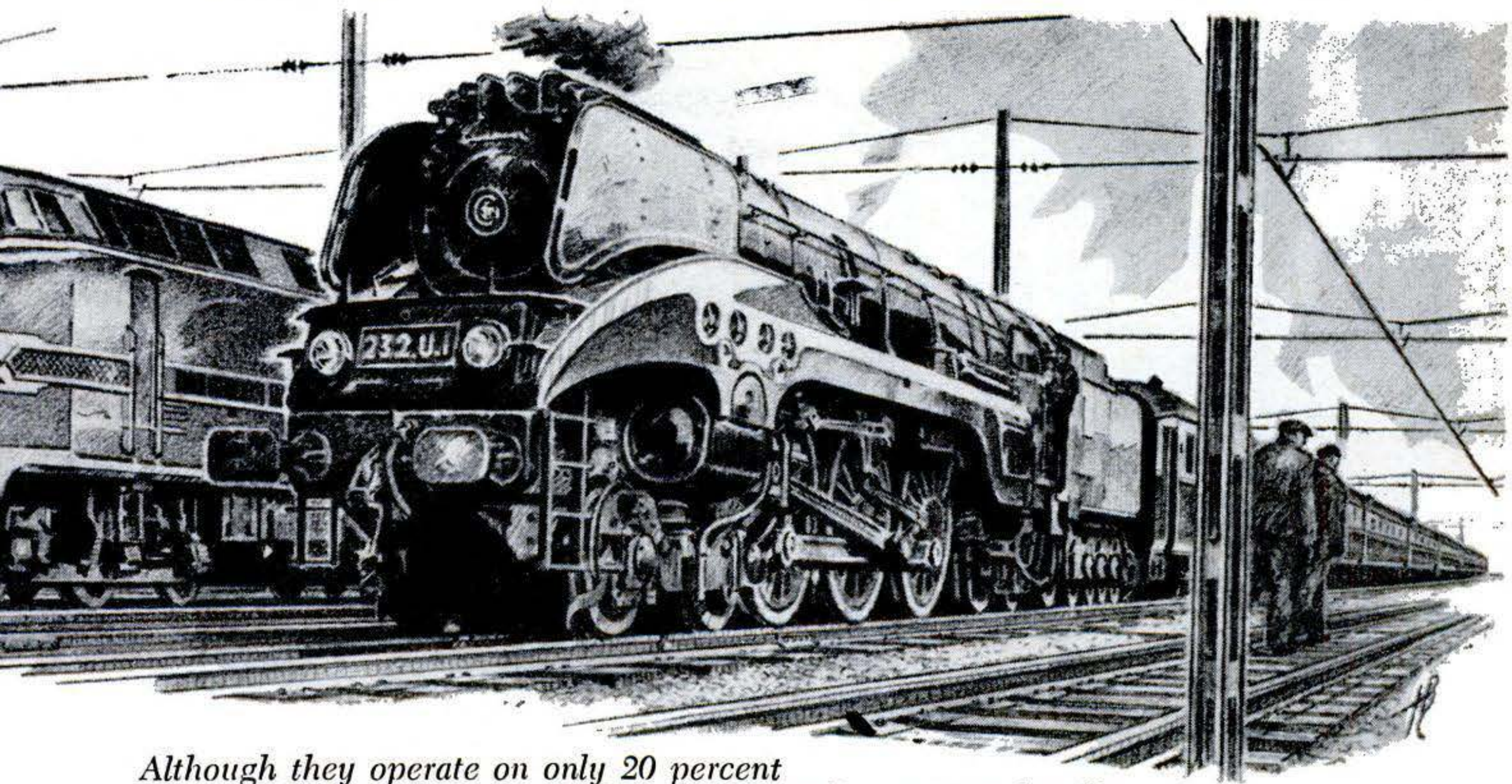
to the French railroads. Maybe they would in the U.S., too



Although they operate on only 20 percent of France's 26,500 miles of rail lines, electric locomotives handle 63 percent of all traffic. On other runs, diesels are fast replacing the last 3,880 steam locomotives.

section of our country where railroad headaches are most acute. That's New England, the Middle Atlantic States, and Ohio, combined.

• There is no complaint from French labor on the accelerating swing to railroad automation. American visitors have long been jolted by the sight of Gallic freight trains skimming across the countryside without caboose or train crews. Now, at one terminal, switching locomotives without engine crews are controlled

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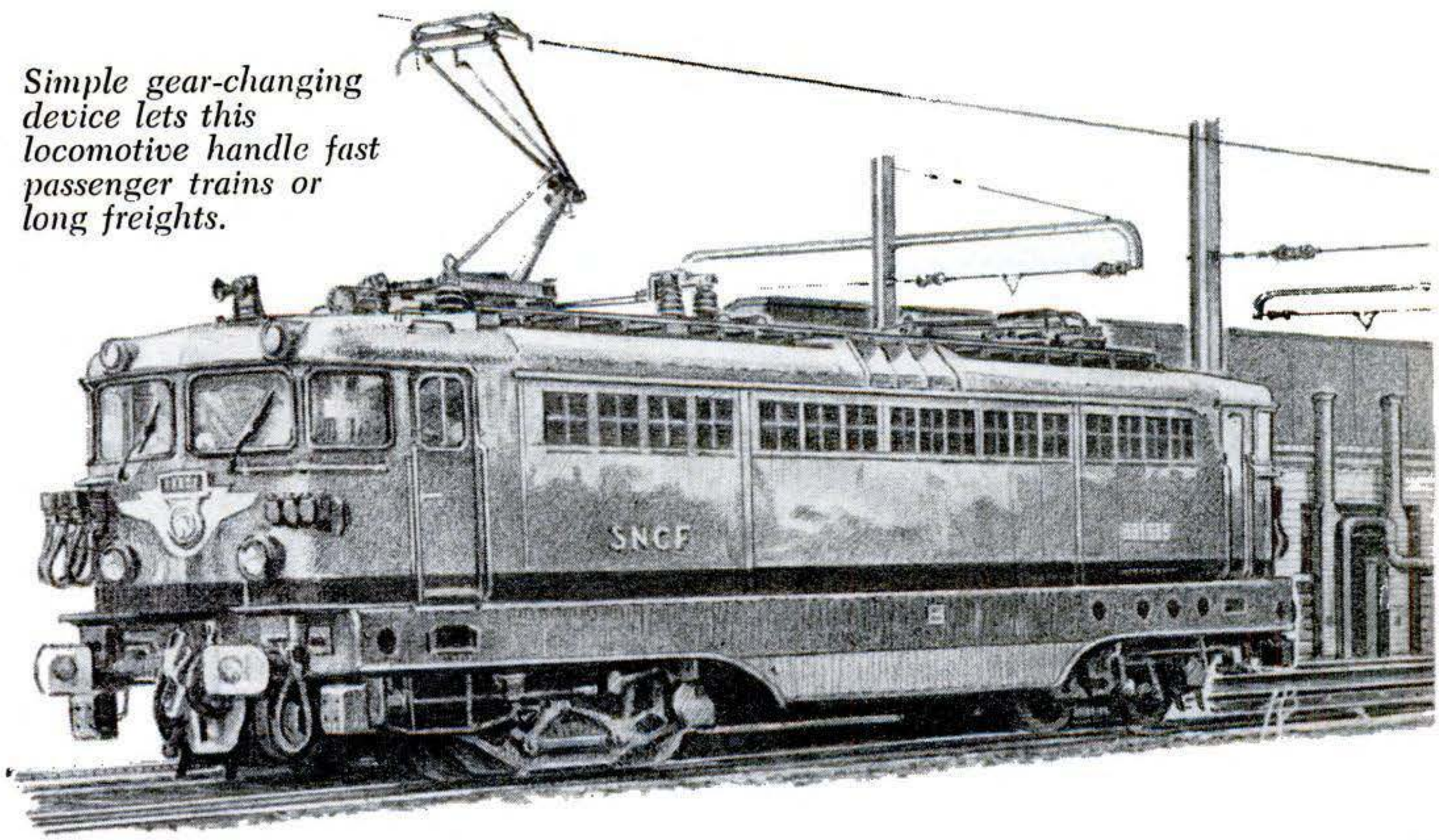
Simple gear-changing device lets this locomotive handle fast passenger trains or long freights.



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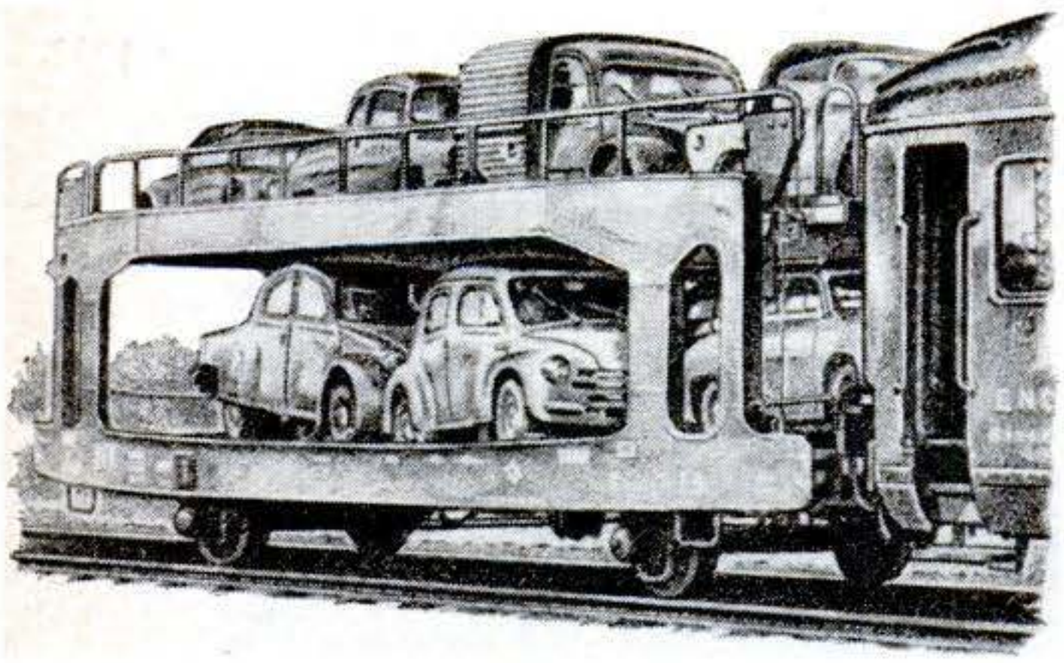
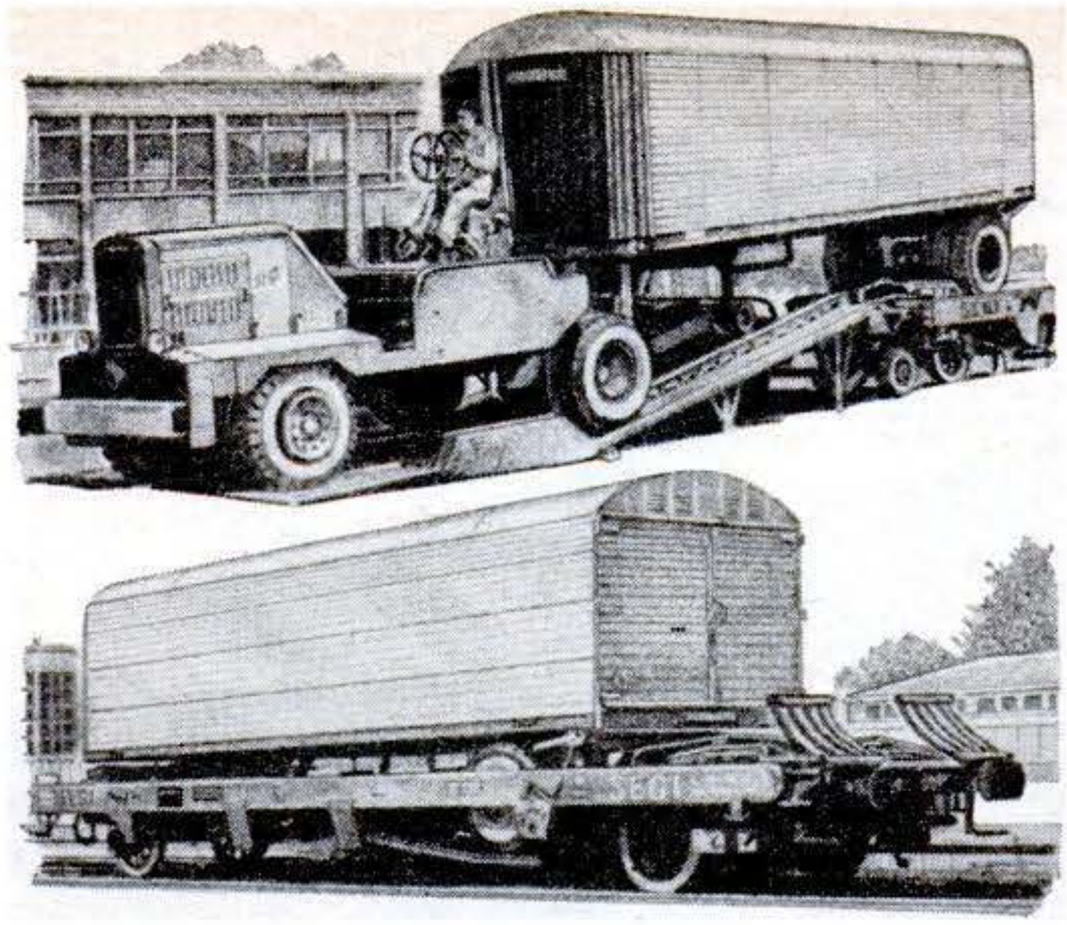
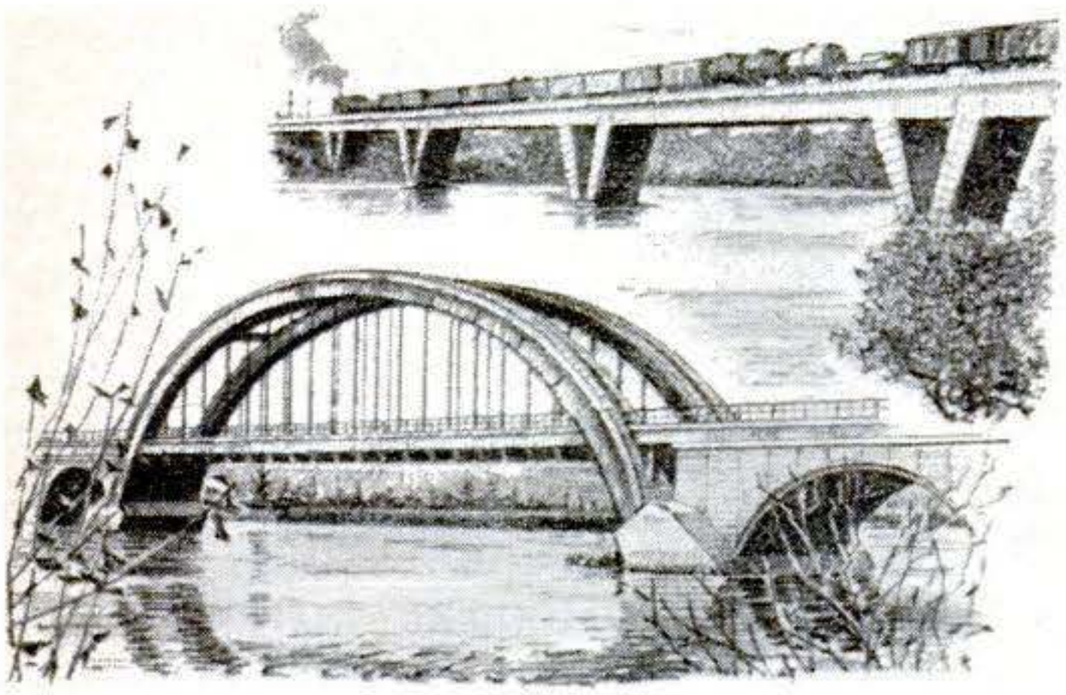
Recipe: To proven practice add a dash of imagination

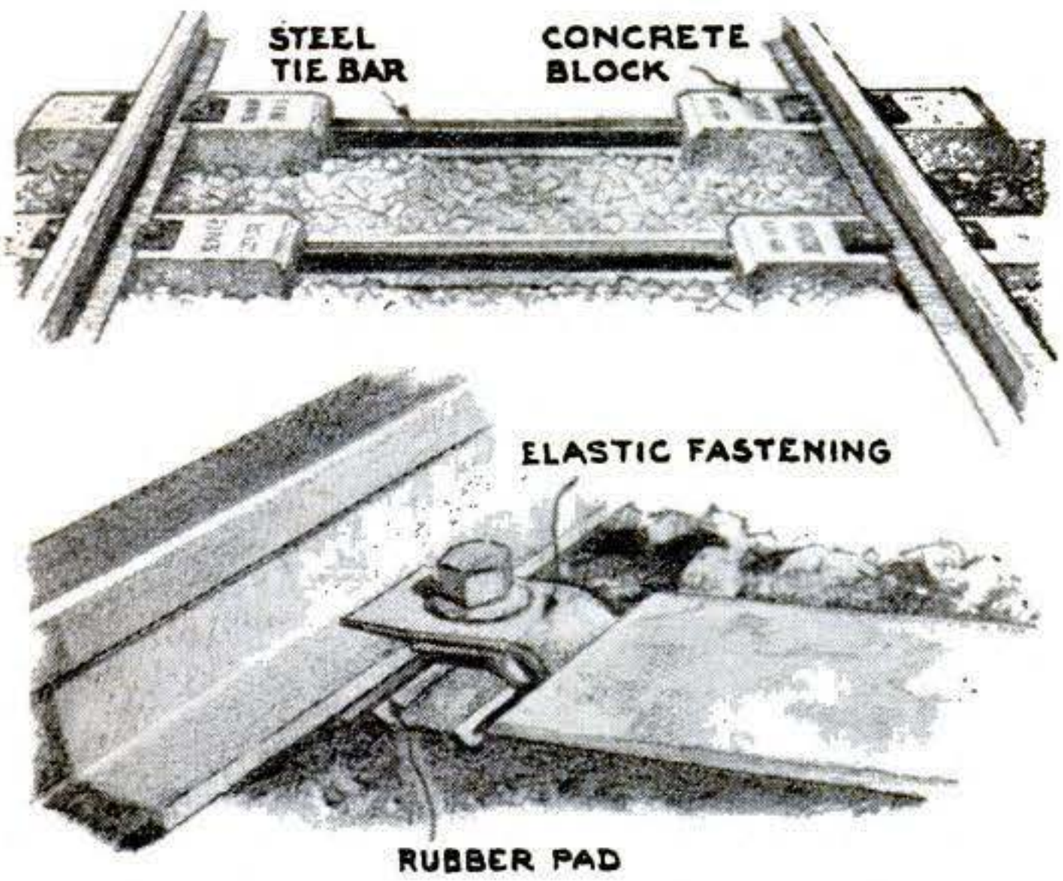




With setup above, vacationers who prefer sleep to a long drive between Paris and Avignon can have their cars at the end of the run. Tractors that carry their own ramps (right) provide "kangaroo" service almost anywhere



Outstanding concrete bridges cross the Rhone. At top: 980-foot prestressed job is longest ever built. The 407-foot arch is biggest made of reinforced concrete.



Concrete block and steel tie-bar sleepers are replacing oak ties in trackwork. Half-mile lengths of welded rail are securely anchored, but rest on rubber.

by radio from a central tower. Big push-button classification yards like Villeneuve, south of Paris, handle 5,000 cars a day with as much aplomb as the Pennsylvania R.R.'s fever-hot Enola Terminal, near Harrisburg.

Why no fuss? Because French manpower is in short supply. There have been no layoffs. But to compensate for ever-growing mechanization, only 10,000 new employees are hired each year. This is more than offset by the number of annual retirements.

To harassed U.S. railroads, the French setup sounds like that mythical high-iron paradise, "The Big Rock Candy Mountain." Except for one thing.

SNCF is a state-controlled-and-operated system. Under a long-range changeover plan, private investors still have a 47-percent stake in the plant. But by 1982, all their holdings will have been bought in by the government.

Admittedly this French nationalization venture has been successful. A similar solution to the American railroad problem would run cross-grain to our system of free enterprise.

That shouldn't stop us from reversing foreign aid a bit, to profit from SNCF savvy where it suits our needs. We could make a good start by heeding the blunt words of that grade-crossing guard.

[Continued on page 190]

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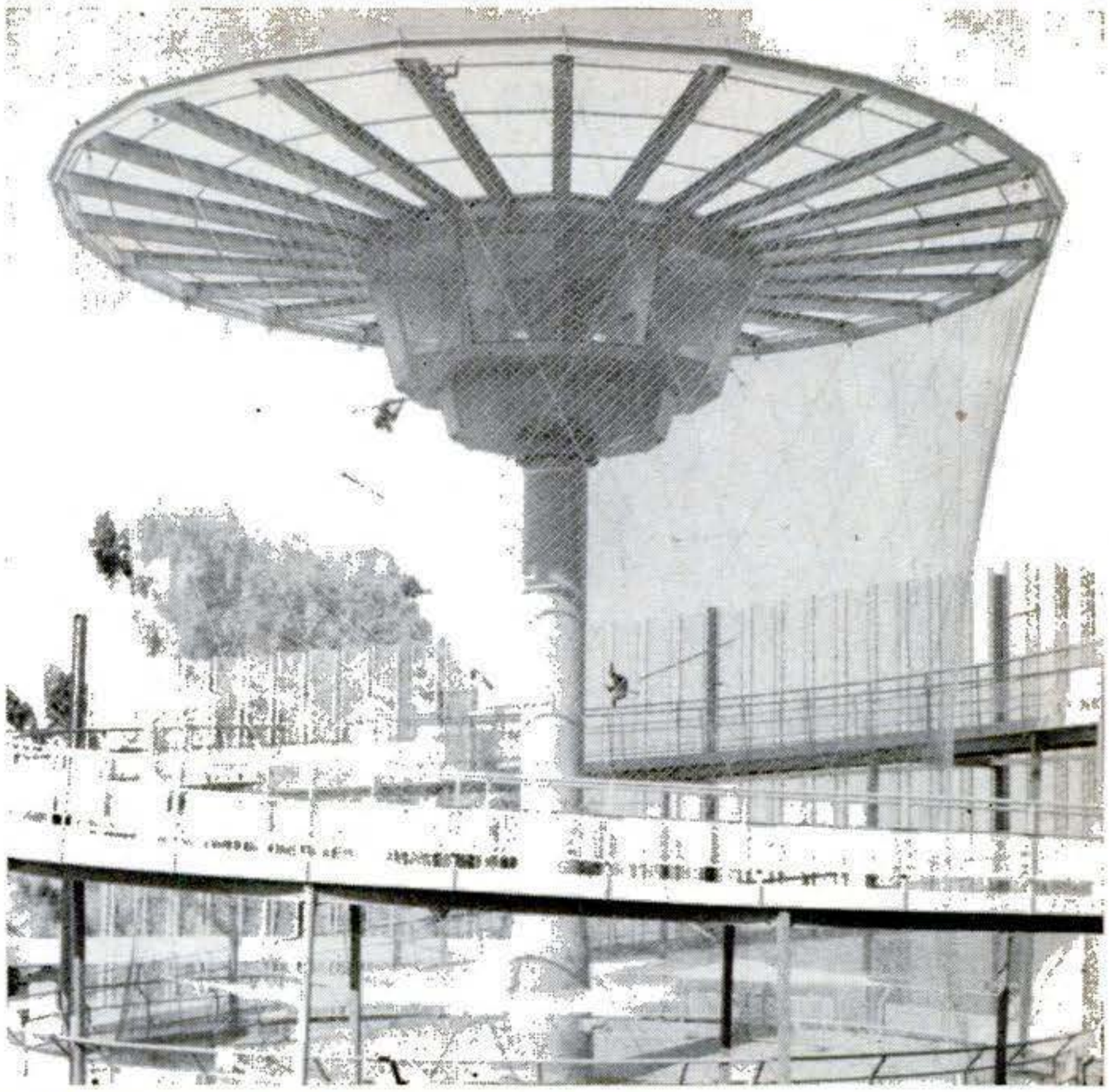


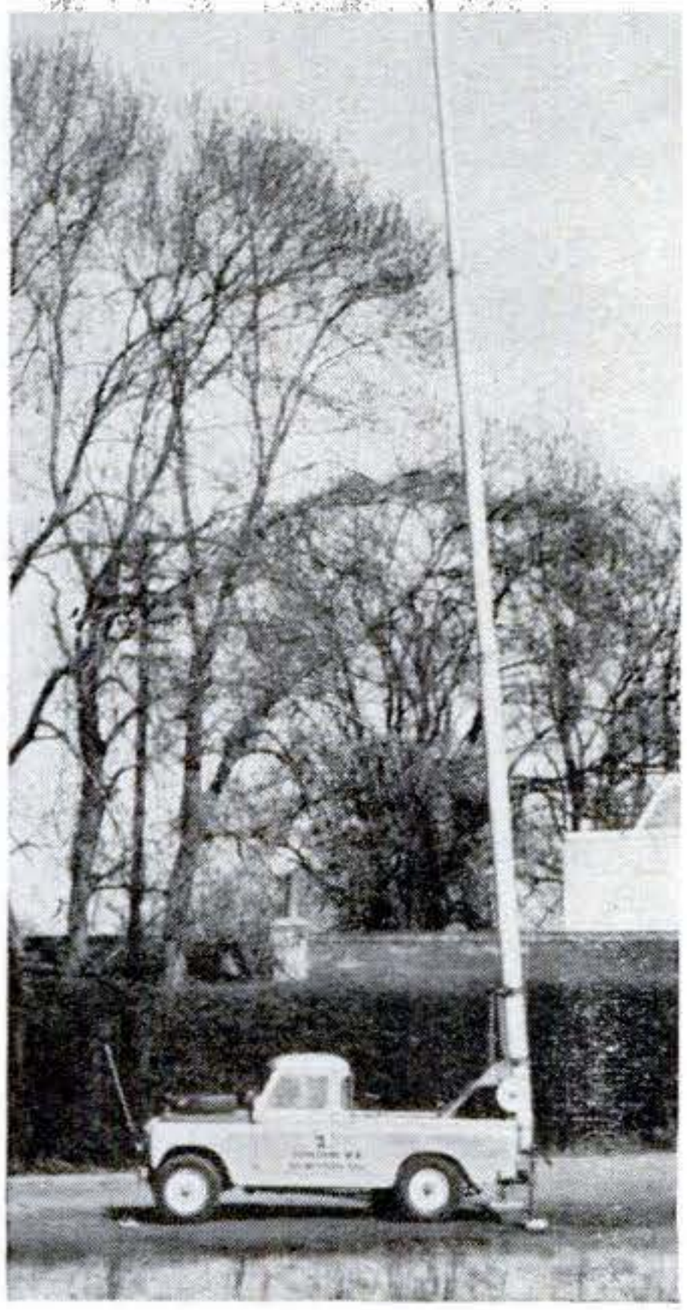
Gibbons swing on trapezes for visitors on ramp. Tunnel to base and ladder inside upright give keepers access to lofty cage.

Wire mesh encloses zoo's monkey cage

The new gibbon cage in Oakland, Calif., not only dominates the entrance to the Knowland State Arboretum and Park but also won an award as one of the nine best steel buildings constructed during the year.

Supported by a 45-foot-tall tubular-steel pillar and diagonal arms, the enclosure is a single piece of aluminum-wire mesh specially woven for the purpose. A dozen units provide living quarters for the small apes—six glassed-in rooms with radiantly heated floors alternating with open platforms and connected by swinging plastic doors. Visitors watch from a spiral ramp.

Safety nets break fall of simians from flying trapeze; oftener serve as trampolines for wild leaps, bounces, and tumbles.



Giant monopod

A camera perched atop a truck-mounted telescopic mast takes aerial photos from the ground. The automatic wide-angle 35mm camera is aimed and operated by remote control. Compressed air raises the pole to any height up to 100 feet, retracts it to 22 feet, and tilts it horizontally for transit. A British company uses the rig.

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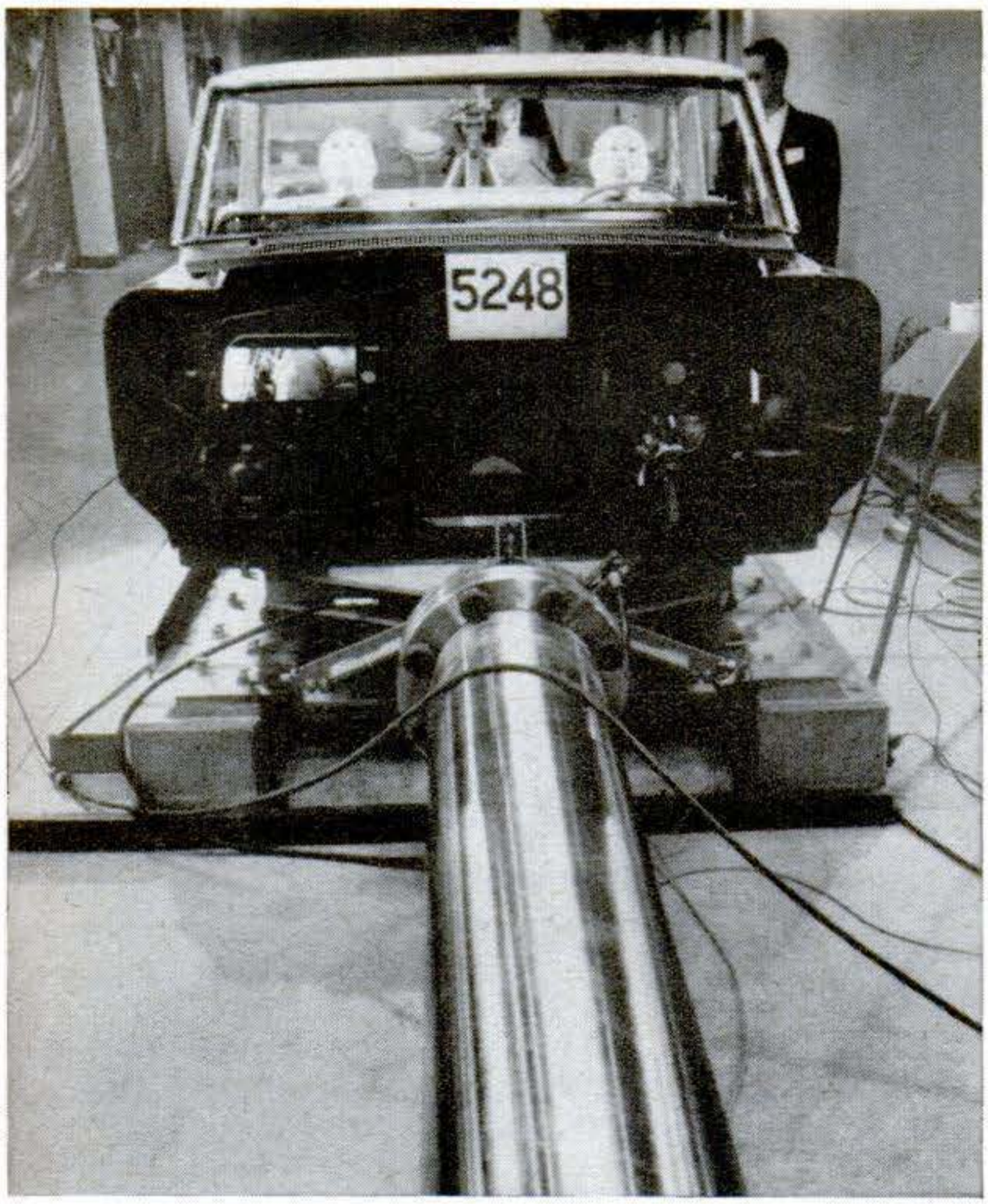
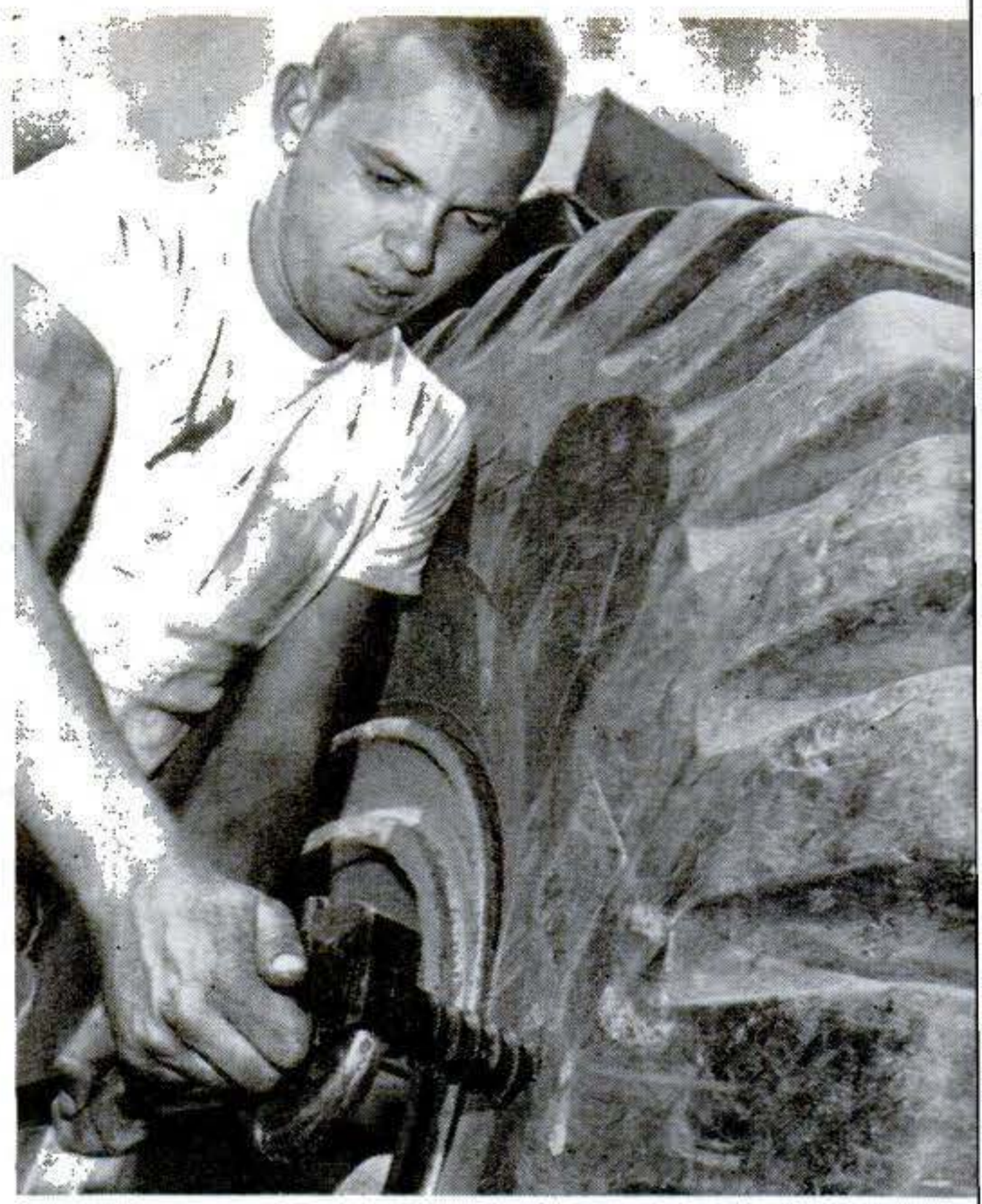


Forty-G sled simulates crashes

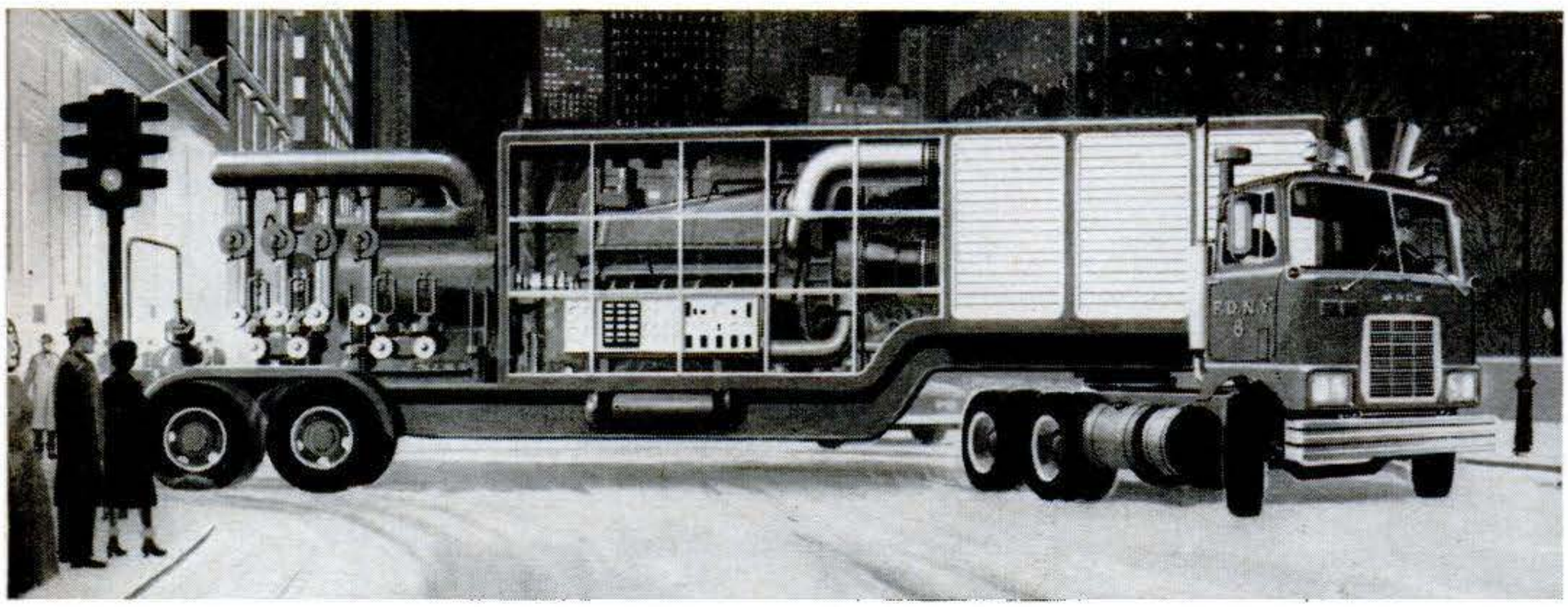
Propelled by a compressed-air piston, this mock-up of an auto body accelerates to put a force 40 times gravity on the two dummies inside. General Motors uses the impact sled to study crash results and test seat belts and other safety equipment. The body can be turned forward, backward, or to either side to simulate a crash from any direction.



Turn of screw plugs leak

Frozen-rubber lag screws are now used to fix punctures in the huge tires on earthmovers and other outsize vehicles. They are made by Goodyear of polyurethane rubber. Some are 10 inches long.

A screw is frozen by dry ice, screwed in, and its head cut off flush. It becomes soft on thawing, bonds with the tire, and is an effective, permanent seal.



Giant truck would outpump fireboat

More powerful than the largest fireboat, a superpumper has been proposed for New York City. It would deliver 20,000 gallons a minute to throw a stream 885 feet high or blast a hole in a concrete wall. A companion hose tender would draw from four fire hydrants or take water direct from a river. Designed by Gibbs & Cox, naval architects, the equipment would be built by Mack Trucks for $875,000.

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Going up on traveling stall . . .

High jinks with high jacks

Hit with a no-overnight-parking law, residents of Tokyo had to get their cars off the street, yet had no space to build garages.

An aircraft firm solved the problem with an electric lift—and is doing a land-office business at $850 to $1,800 each.

One of its 36 models is shown here. A car is driven onto a road-level platform on the street side and a motor is switched on. The platform rises (above) and swings around the upright (below) to rest over the yard. The lift can be stopped at various heights.

. . . for ring-around-rosy stop.

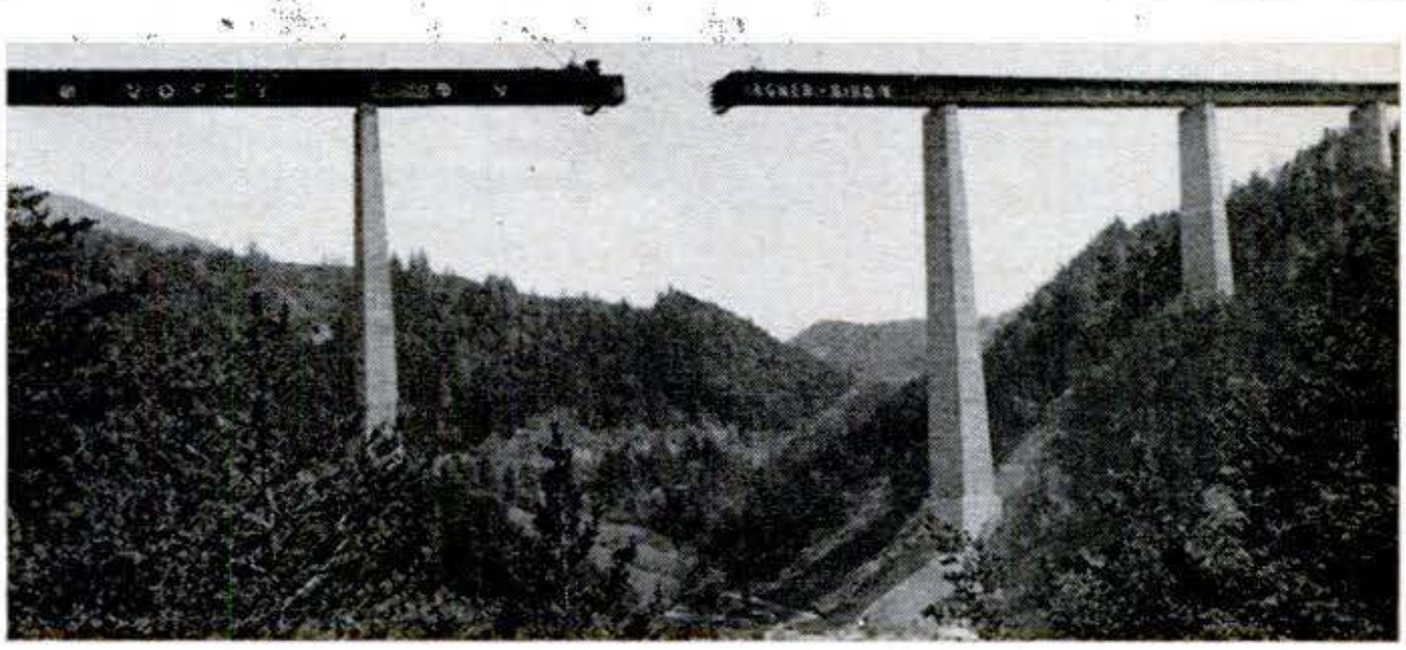
Turbine, behind pilot, burns gas, diesel oil, other fuels.

Copter fits in small trailer. Reassembly takes five minutes.

One-man copter fits inside 12½-foot trailer

A sort of aerial motorcycle, West Germany's Dornier DO-32 is a 90-hp. turbine-powered single-place helicopter. On the ground, its two 12-foot rotor blades and shaft fold on each other along with its landing skids to fit into a 12½-foot box trailer that can be towed by a light car.

Dornier's one-man copter can make up to 75 m.p.h. and stay in the air 50 minutes on a 12.7-gallon tank of fuel. If put into production, it will sell for $9,100.



Bridge in Austrian Alps is Europe's highest

The 600-foot-high Europa Bridge, here lacking only the last 80 feet of its 2,500-foot roadway, spans the Sill Valley near Innsbruck, Austria. The five-lane bridge is the most difficult section of the Brenner autobahn linking German, Austrian, and Italian highways to provide a fast connection between Innsbruck and Brenner Pass.

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Sighting flock of birds, Tom Lee asks tower to notify jet pilot waiting for takeoff. Seconds

Danger on the Runway:

By E. D. Fales Jr.

A BIG European jet whines out on the runway at Boston for takeoff. It reports ready, stands poised. Suddenly—danger.

Ahead, for a merest instant, the pilot has seen the faint flicker of many small wings. In the same instant they're sighted by a special watchman scanning the field through binoculars from Logan Airport tower.

The radio messages almost cross. Tower to jet: "Hold on Taxiway D. Gulls."

Pilot to tower: "Holding. Request bird run before takeoff."

A hundred yards away, in the grass, a golden-yellow Ford station wagon has been waiting. In it are two armed men. The car sprints toward the jet. Then, red light going, siren screaming, it begins a "bird run" ahead of the plane. Its job: to sweep the full length of Runway 33 and drive away all birds.

But birds are stubborn and don't scare as easily as you might think. A cloud of gulls flees before the wagon, but then they turn and settle in the grass close by Runway 33.

This time the radio call is from the station wagon. "Bird Patrol Six to tower: We're going to fire."

The wagon halts, while the jet waits, far back. Two men with shotguns jump out. They fire, and the sound echoes to the tower.

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"Car Six to tower: Please advise all pilots at once . . ."

later, armed guard (right) jumped in wagon and sped off to scare birds away from airport.

How Birds Cause Crashes

The birds merely rise and settle again. This time the patrol pulls a surprise. One guard loads a special shell, a "cracker." It contains an honest-to-goodness firecracker, a Chinese giant.

The gun fires with a small *plop*. The projectile sails up like a mortar shell, fuse sputtering. For three seconds it burns, then falls right in the midst of the defiant gulls.

Whaam! The noise is terrific. The gulls, alarmed at last, rise screaming and head for a distant dump. The jet radios its thanks, wheels out with a roar,

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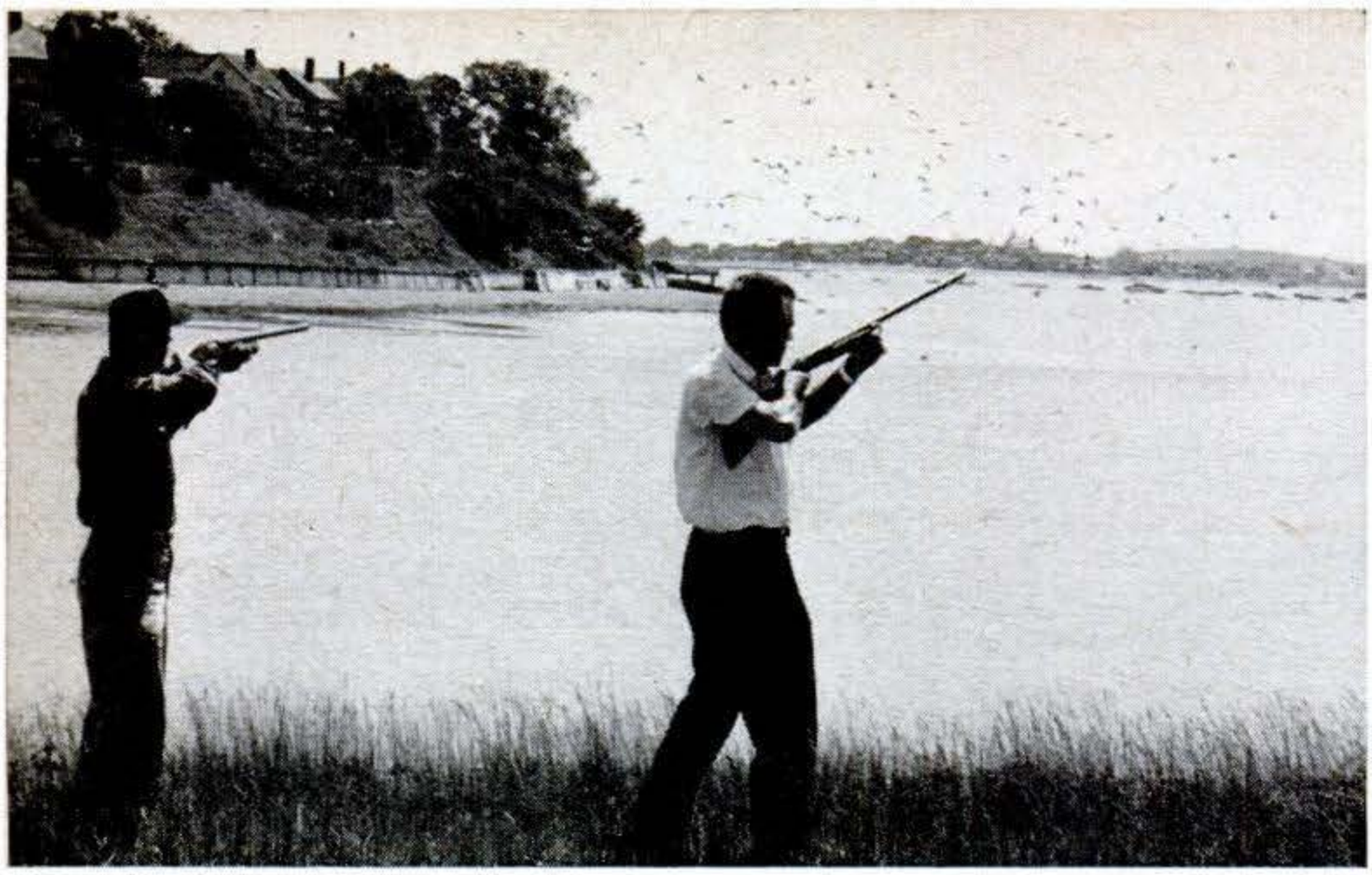
Patrol Six men watch airliner thunder out for takeoff, await call from pilot for "bird run."



Sighting squadron of gulls moving toward field, guards hurry to edge of field to open fire with big "cracker" shells and drive birds away. This sort of patrol, which experts say should be copied at many other airports, keeps Logan Airport safe for jet passengers. Boston has three patrols.

and soon climbs its smoke ladder into the sky.

The feathered menace. Bird patroling is routine at Boston—one of the few airports, pilots say, awake to the danger of bird flocks on runways. Until a few years ago, birds had never wrecked an airliner. They were never thought to be a deadly hazard—and still aren't by some airport officials who may be inviting disaster.

But one October day at Boston, three years ago, a big Eastern Air Lines Electra cartwheeled to destruction, its jet engines choked by starlings. And only days later a huge DC-8 also plowed into birds on takeoff, luckily was able to stop. On Nov. 23, two autumns ago, a United Air Lines Viscount flying from Newark, N.J., to Atlanta, Ga., was wrecked in midair by whistling swans.

Since then there have been other near-disasters. At one air base a big military jet carrying a Polaris submarine crew smashed into gulls on takeoff. Only skill and luck brought it to a safe landing. At least two jet fighters have been "shot down" by birds. Recently a third, an F-102, flamed out when birds choked its engines. Going too fast to stop his takeoff, flying too low to eject, its pilot frantically hit the ignite button. The engine started again, and again flamed out. Then the pilot made a discovery. By hitting the button over and over he could keep his engine starting in bursts —enough to bring him to a landing.

Over Elko, Nev., one November day a Western Airways Electra was cruising along smoothly at 21,000 feet when a worried-looking stewardess appeared in the cockpit.

"Passengers in the rear have just heard a small explosion," she said.

The plane made an emergency landing. In one horizontal stabilizer there was a hole big enough to have been made by an eight-inch shell. Could a bird have done that? At 21,000 feet? It seemed incredible. The pilot guessed that an eagle might have flown into the plane's path.

A solitary clue gave the answer: In

"Zon-Gun," fed by acetylene tank, is set up to fire ear-shattering booms that drive birds away. This small cannon is only one type of bird-scaring device used at the Boston airport.

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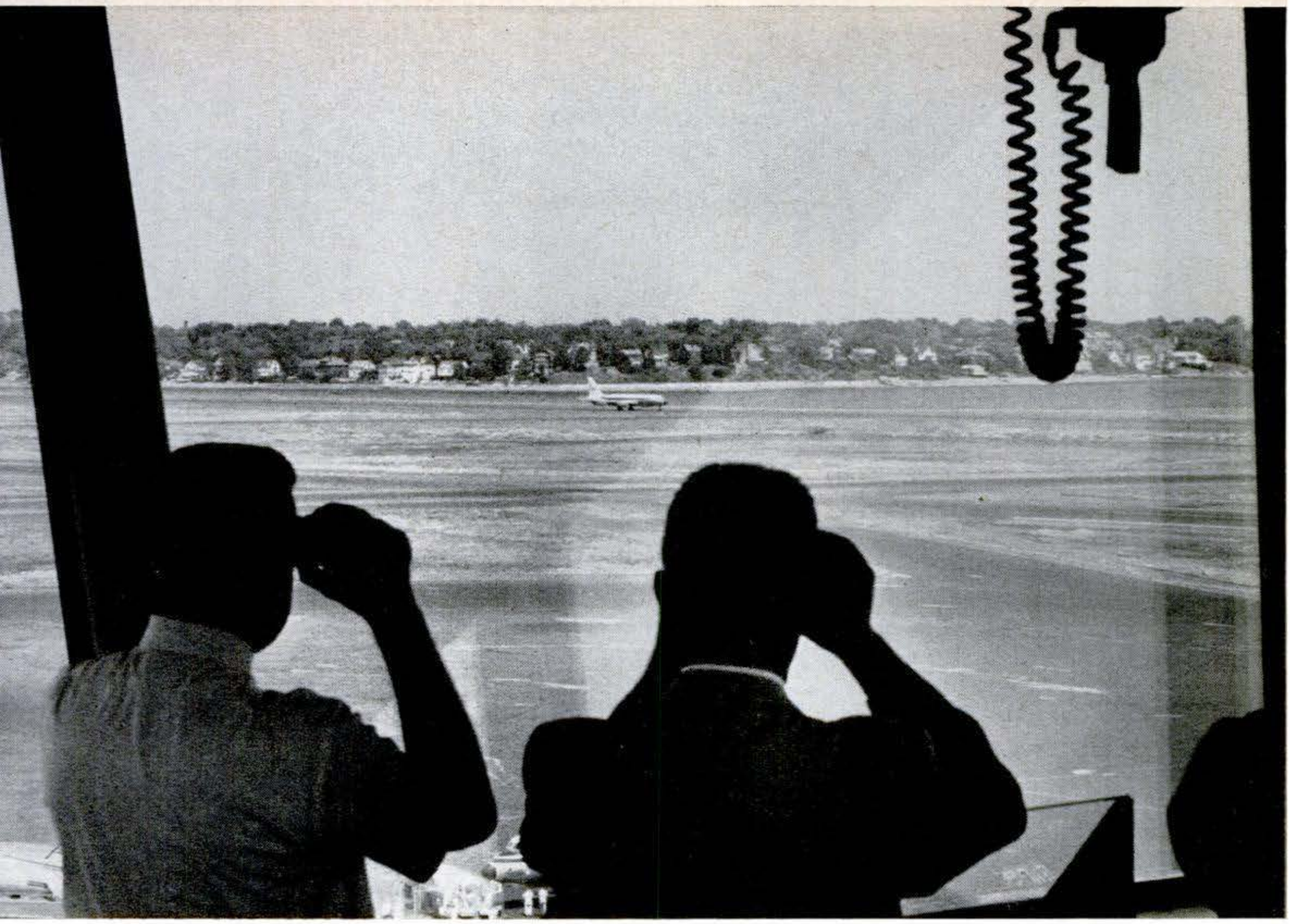

Working side by side, a U.S. Wildlife Service man and Logan field traffic man search landing area as a jet hits the runway. If birds are sighted, patrols will be radio-dispatched to clear field.

the hole was a bit of fluff, all that remained of one feather. No eagle, but a mallard duck—flying four miles up—had hit the plane.

Searching for answers. The Federal Aviation Agency (FAA) is hard at work seeking the answer to bird hazards in flight; so are plane and engine makers. But it will take time. Meanwhile, pilots and safety men say, a lot needs to be done at airports. "We shudder," says one pilot, "when we fly into a certain Florida airport—because of gulls."

Recently an Audubon Society scientist, Dr. William Drury, flew to Europe on contract for FAA to see how dogs, falcons, and mechanical bird devices are used there. Then Dr. Drury flew home. If he needed proof that birds were a real danger he had it coming: As his plane came in for a landing at a U.S. field it rammed into a feathery flock of birds.

Dogs and falcons have not been tried at U.S. airports yet, but some other spectacular methods have. New York's sprawling Idlewild has 100 ear-splitting can-

[Continued on page 206]

Trouble everywhere

Gulls plague seacoast and Great Lakes airports. Crows hover over some inland fields. Observers at some Texas airports have seen blackbirds in such numbers that they "darkened the skies." Canada's worst airport headache is snowy owls.

Sparrows, larks, ducks, sandpipers, hawks, and plover are a problem at many fields. According to inspectors no fields are immune—not even small private ones.

Bird lookouts are needed especially in the spring and fall migration seasons when millions of birds are flying south across the airways. Says one safety man: "They like our airfields since they've actually become bird sanctuaries.

"Nobody wants to get rid of birds. But to save human lives we've got to keep them away from our planes."

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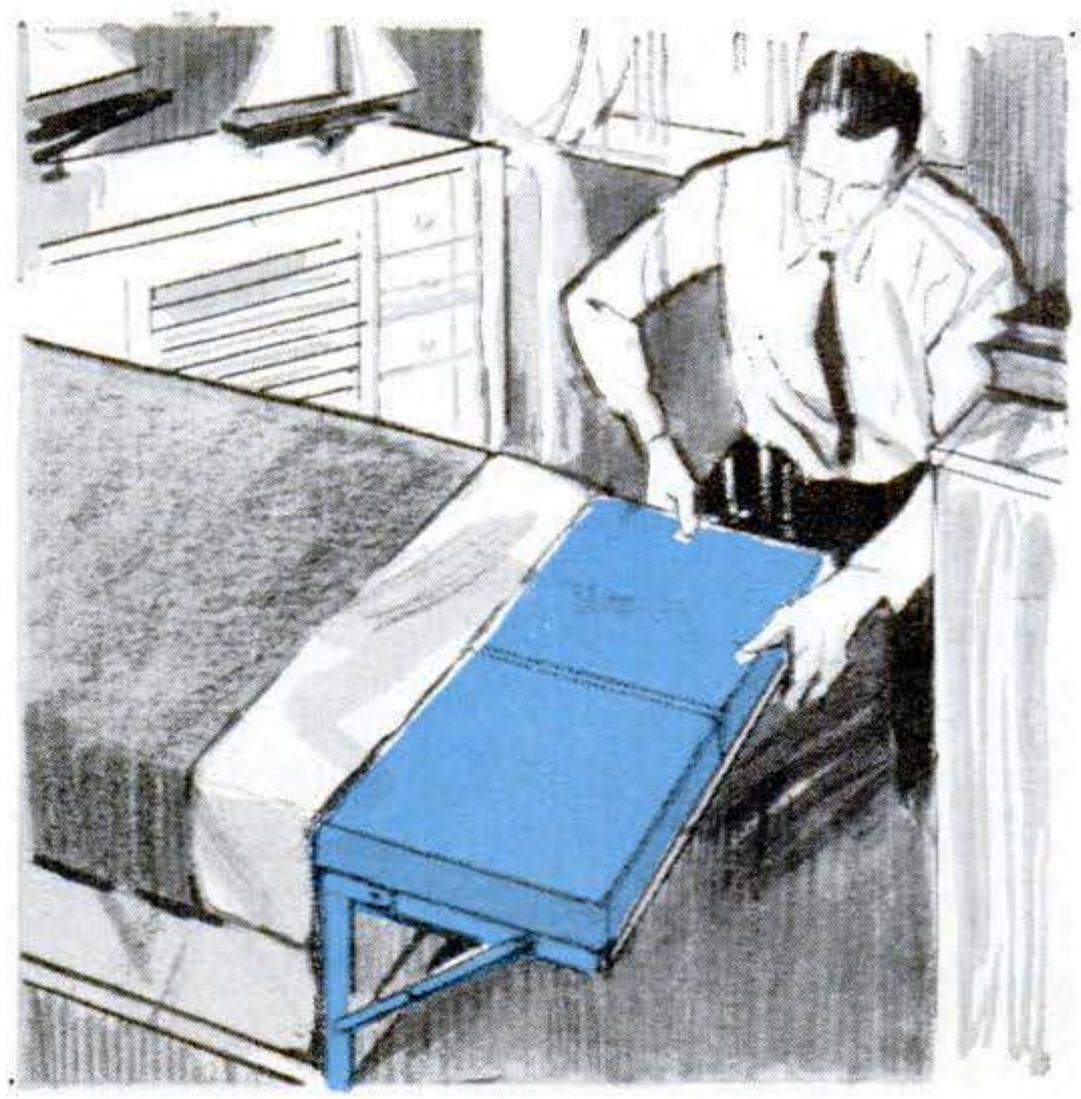
New ideas from the inventors

Spinning lamp lights wide area. To replace the large number of floodlights usually needed to illuminate a wide area, this recent patent would mount a single high-powered light on a revolving, motor-driven yoke. Although the beam would light only a portion of the area at a time, by rotating fast it would give the effect of complete coverage.

Lunch box doubles as tray. You wouldn't have to grapple with a lunch-box meal if you carried it in this plastic box. After unhooking the domed top (with its clipped-in vacuum bottle), you'd let down the hinged sides to form a tray. Blocked-in ends would keep food from sliding and catch spills if the box were used as a lap tray.



Padded platform extends bed. Let down during the day, this hinged, adjustable, foam-padded bed extension would give you extra floor space in a crowded room, say, or a den-guest room. Raised, it would extend the bed to comfortable sleeping length. Pulled up, it would prop a pillow for comfortable reading.

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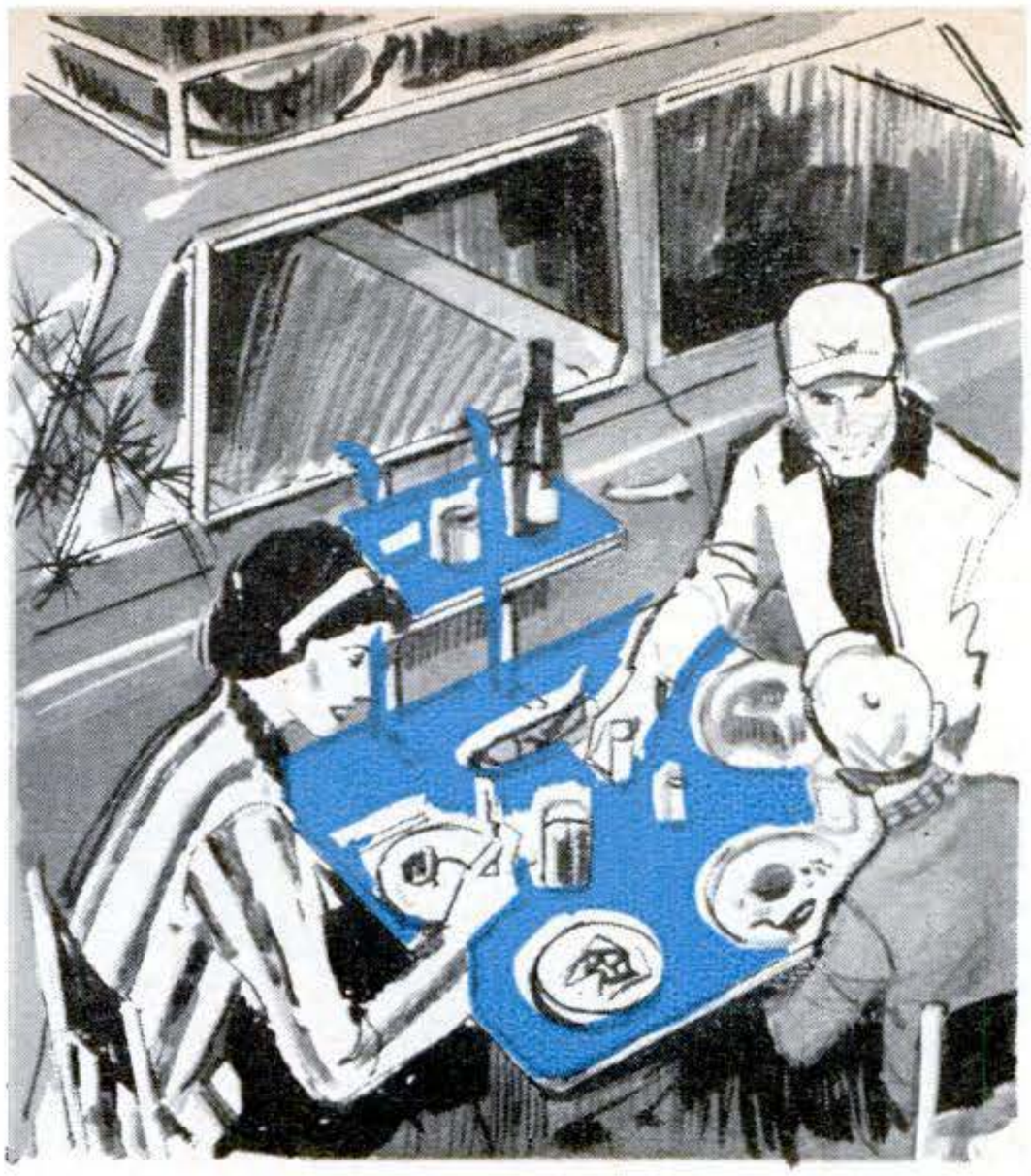
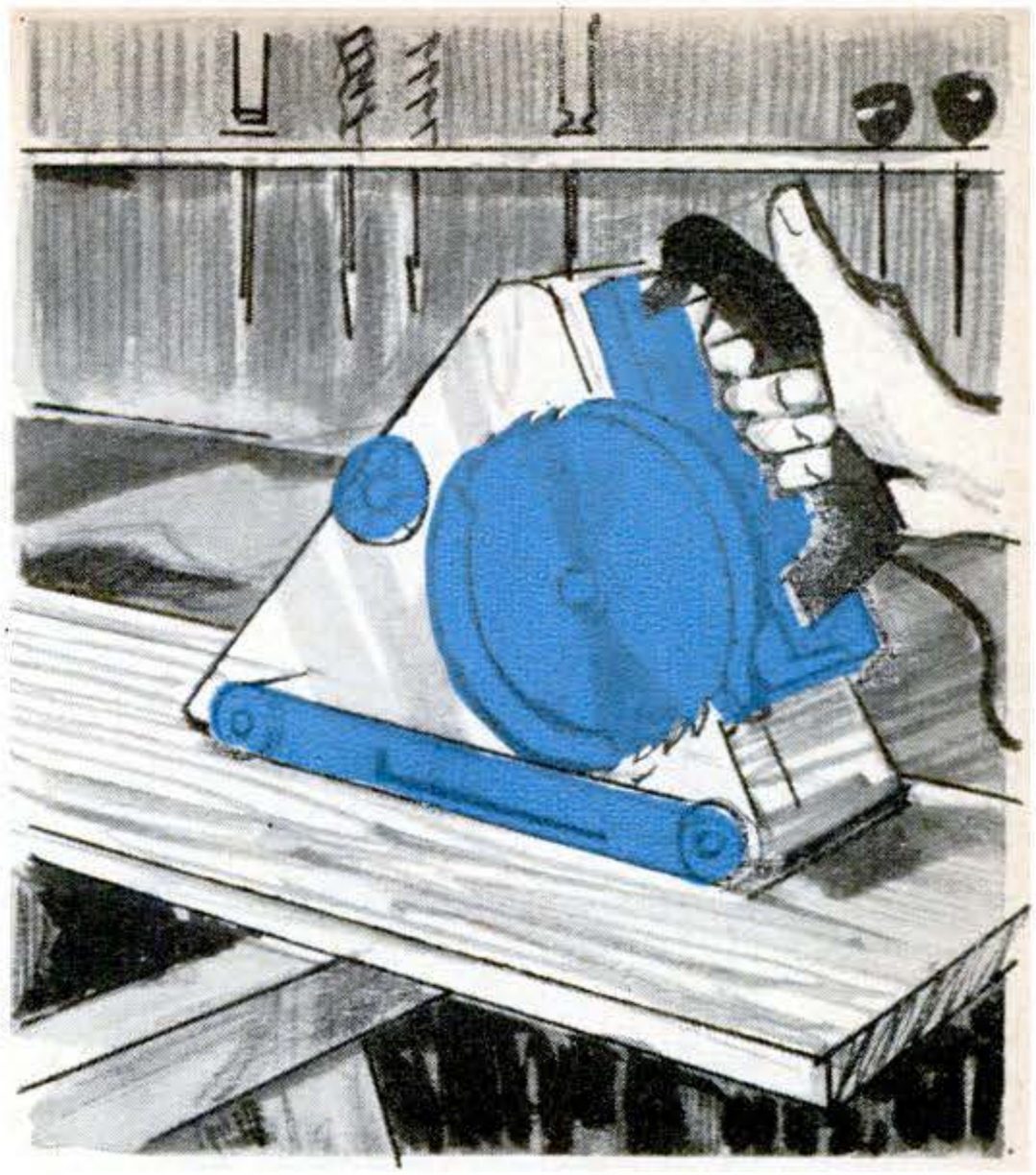
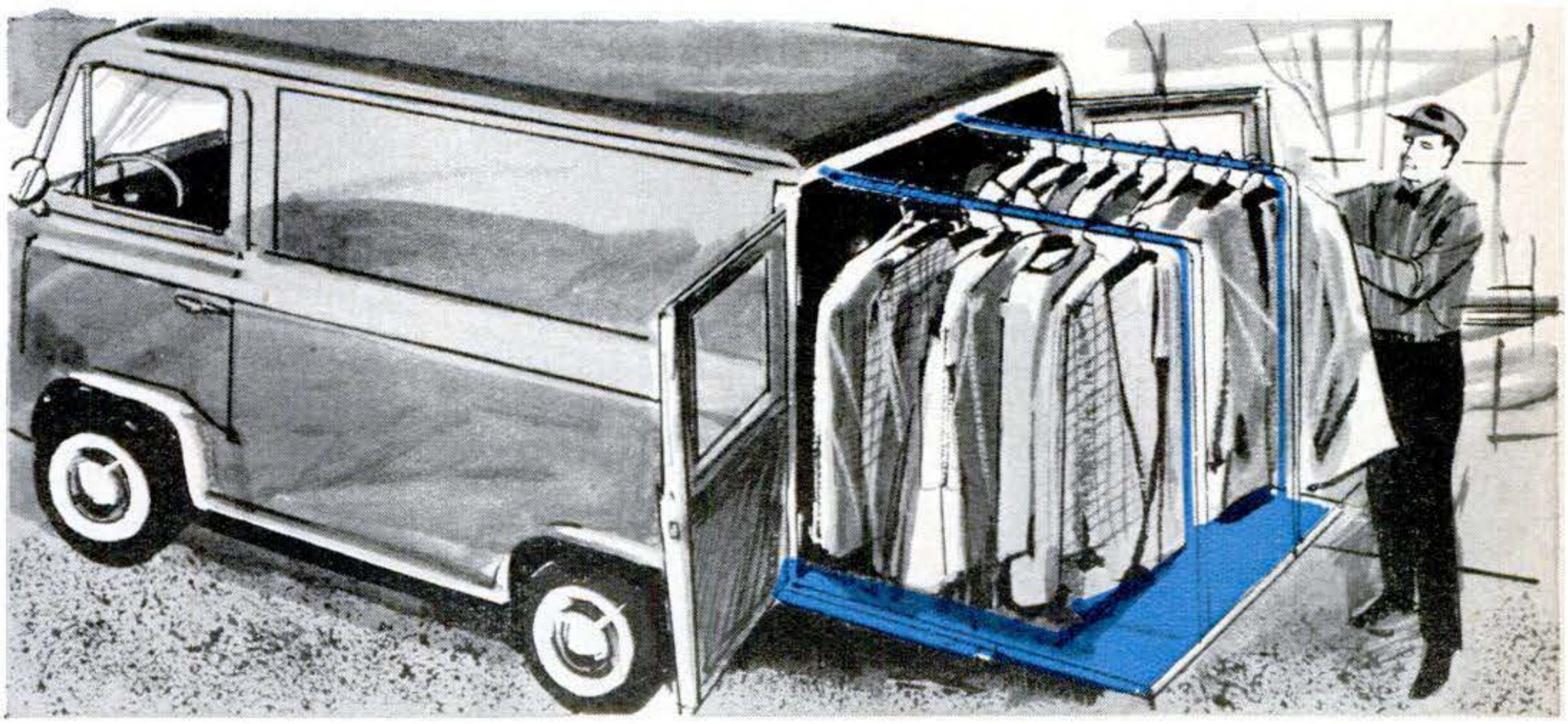


Car door holds camp table. You could enjoy more comfortable camp-out meals or quick roadside picnics if you carried a two-level folding table like this. Hooked to a car door, it would be firm and level even if the ground wasn't. It would open and fold away quickly, take up less space than a conventional table.



One motor drives three tools. With this versatile woodworking tool, you could saw, plane, or sand, going from one to the other with only the simplest adjustment: moving the handle around to one of the tool's three sides. Locking the handle in place would automatically engage the drive shaft with the idler of the selected tool.



Slide unloads truck. A delivery van or other truck might carry a bigger load in better order on this slide-out platform. The simple mechanism, similar to a file drawer in operation, would eliminate the need for walk-in space, simplify loading and handling of the cargo, and make any part of the load accessible in any order.

The following patents have been issued on these inventions. **Motorized lamp**—*No. 3,049,615 to E. C. Sawyer, Brighton, Mich.;* **Lunch-box tray**—*No. 3,054,501 to R. E. Maynard, Denver;* **Bed extension**—*No. 3,064,278 to W. E. Broyles, Kansas City, Mo.;* **Car-door table**—*No. 3,037,639 to Guy A. Kost, Tulsa, Okla.;* **Multiple power tool**—*No. 3,052,270 to Lauritz Tangen, Fairhaven, Mass.;* **Truck slide**—*No. 3,028,025 to George H. White, Flint, Mich.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 25 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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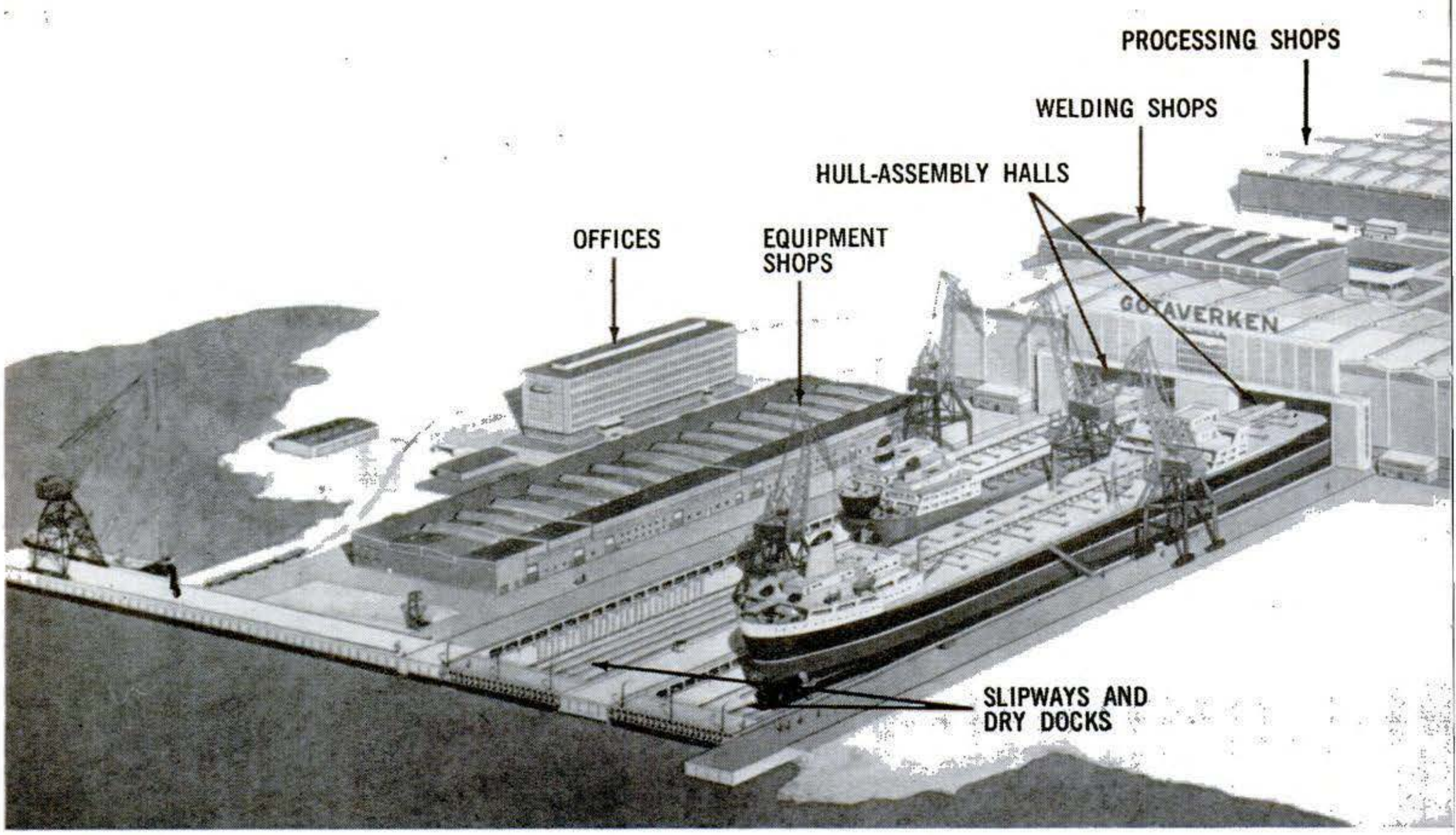


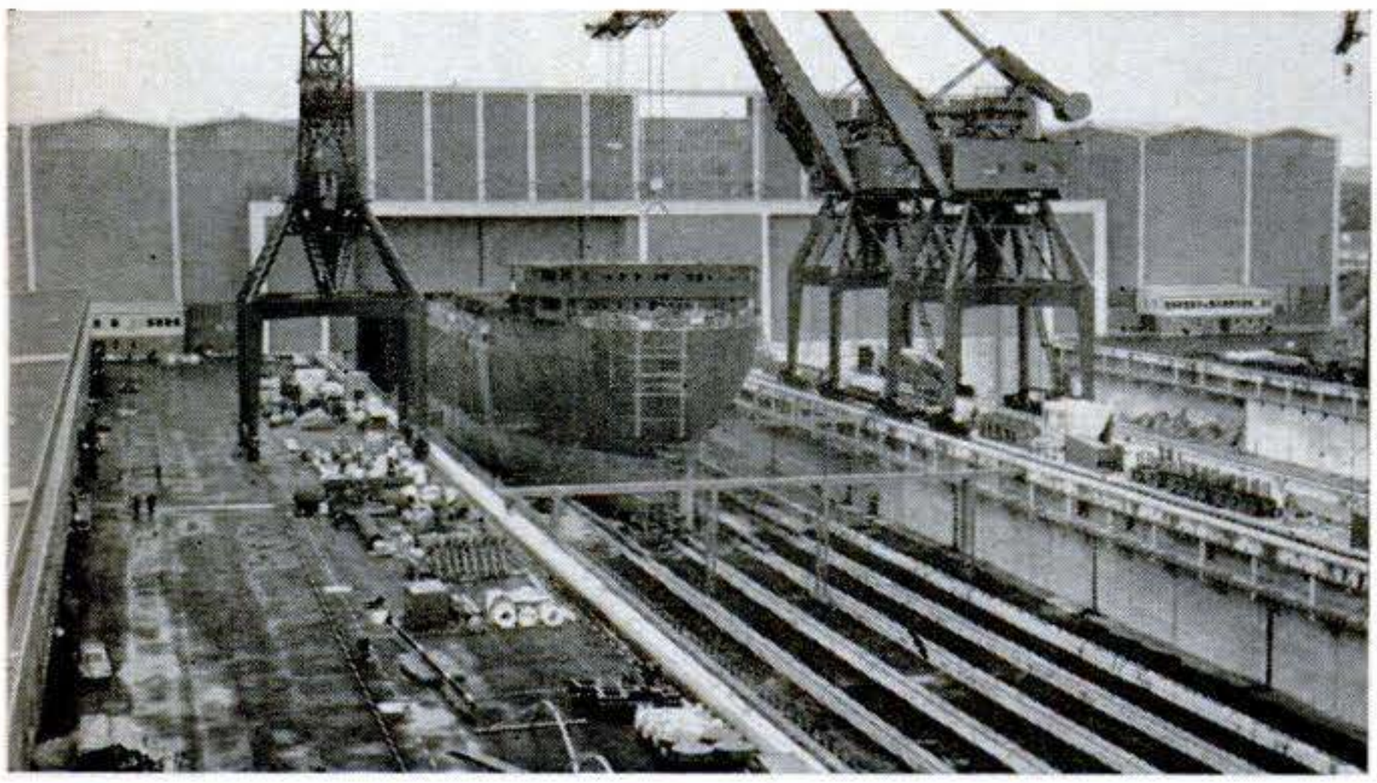
Two 25,000-ton ships built side by side go into same dry dock. One supertanker uses next.

Automated yard builds ships indoors

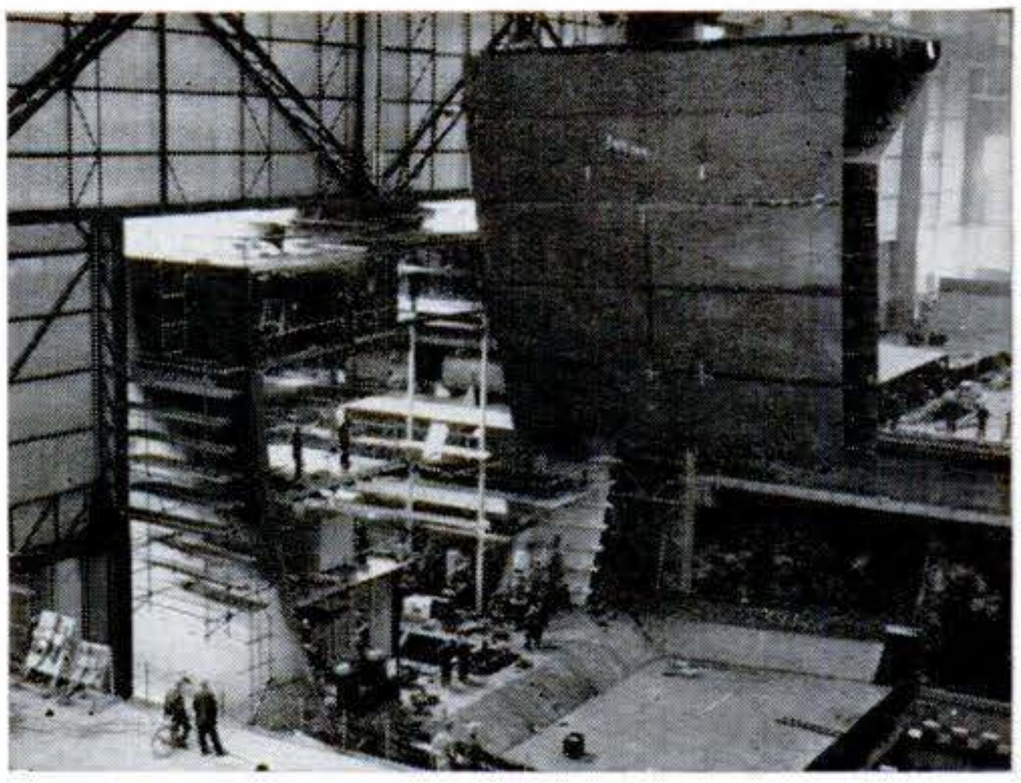
This Swedish shipyard builds tankers in an enclosed hall, then pushes the parts into open docks as work proceeds. Combined with highly mechanized prefabrication and elimination of delays due to weather, construction at the Götaverken Arendal yard in Gothenburg halves time and cuts costs.

Plates are processed on a 4,250-foot conveyor-belt system, remote-controlled from a nerve center that has closed-circuit TV to observe operations, phone contacts to all stations and overhead cranes, and radio links to trucks on the floor. Magnetic cranes start plates on the belt, which carries them through a shot-blasting plant to remove rust, a marking station, and flame cutters. After bending, plates are welded into sections that are moved by traveling cranes to the main assembly hall.

Instead of being built from the keel up, vessels are assembled from stern forward. After the stern is erected, it's pushed outside by hydraulic rams, sliding along a slipway. The building is then closed off by an intricate gate system of sliding,



Complex system of doors and shutters seals off construction hall as ship hull emerges stern first on slipway into dock.



Sections of up to 300 tons are fitted into place inside hall.

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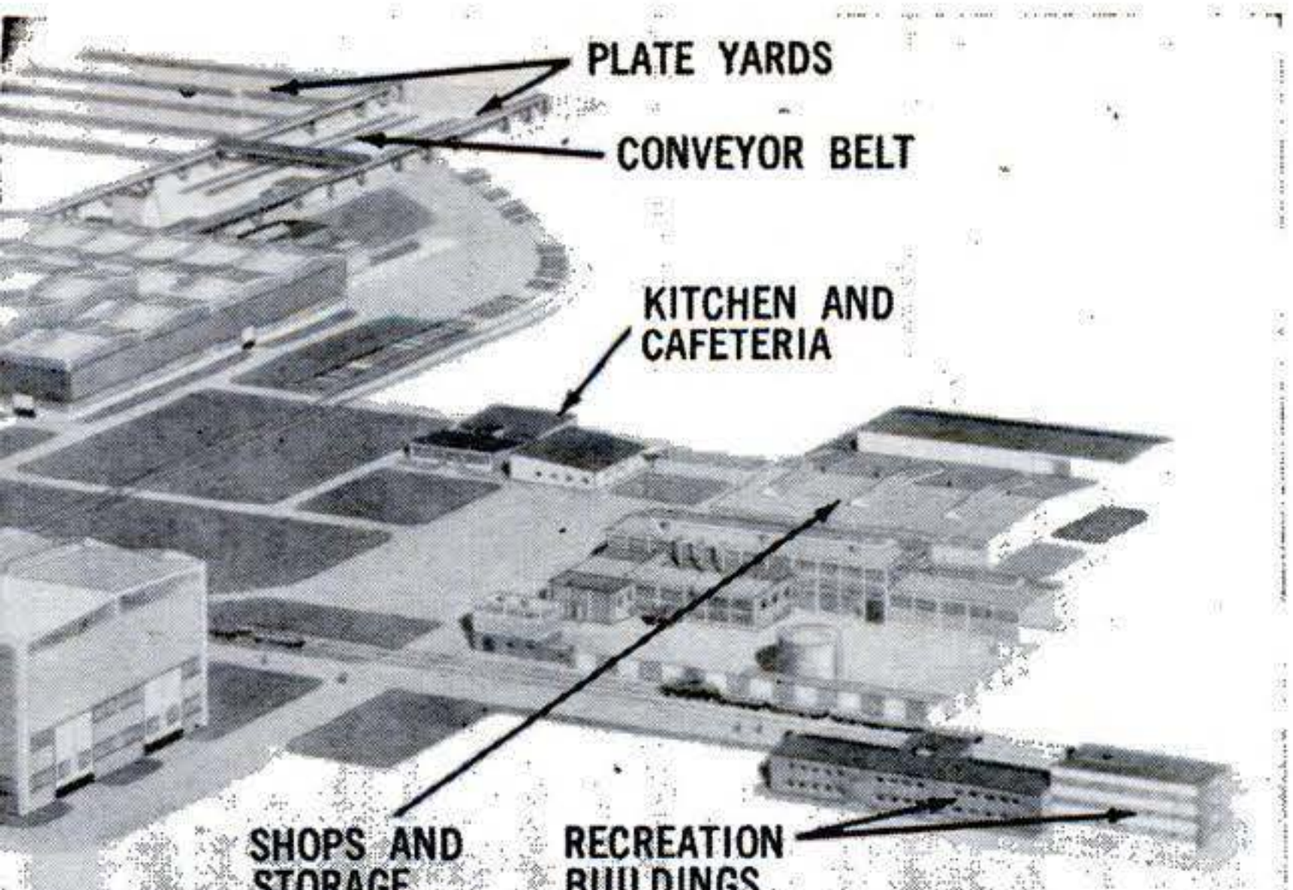
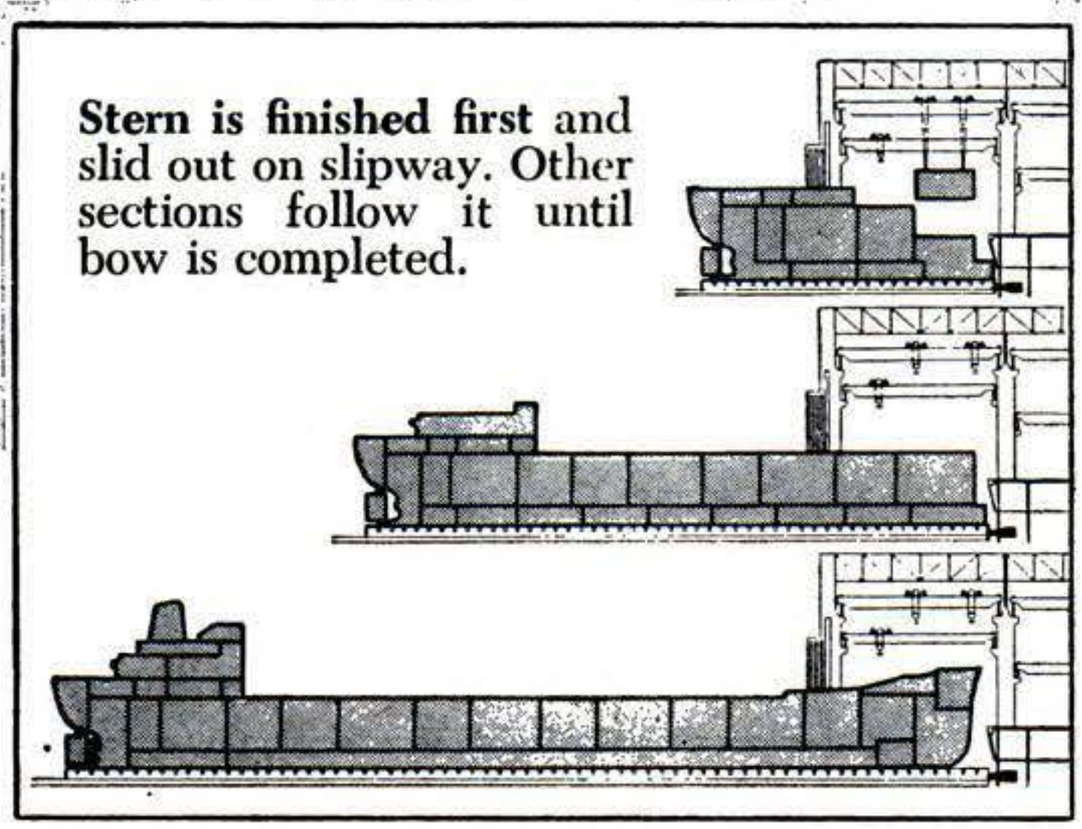
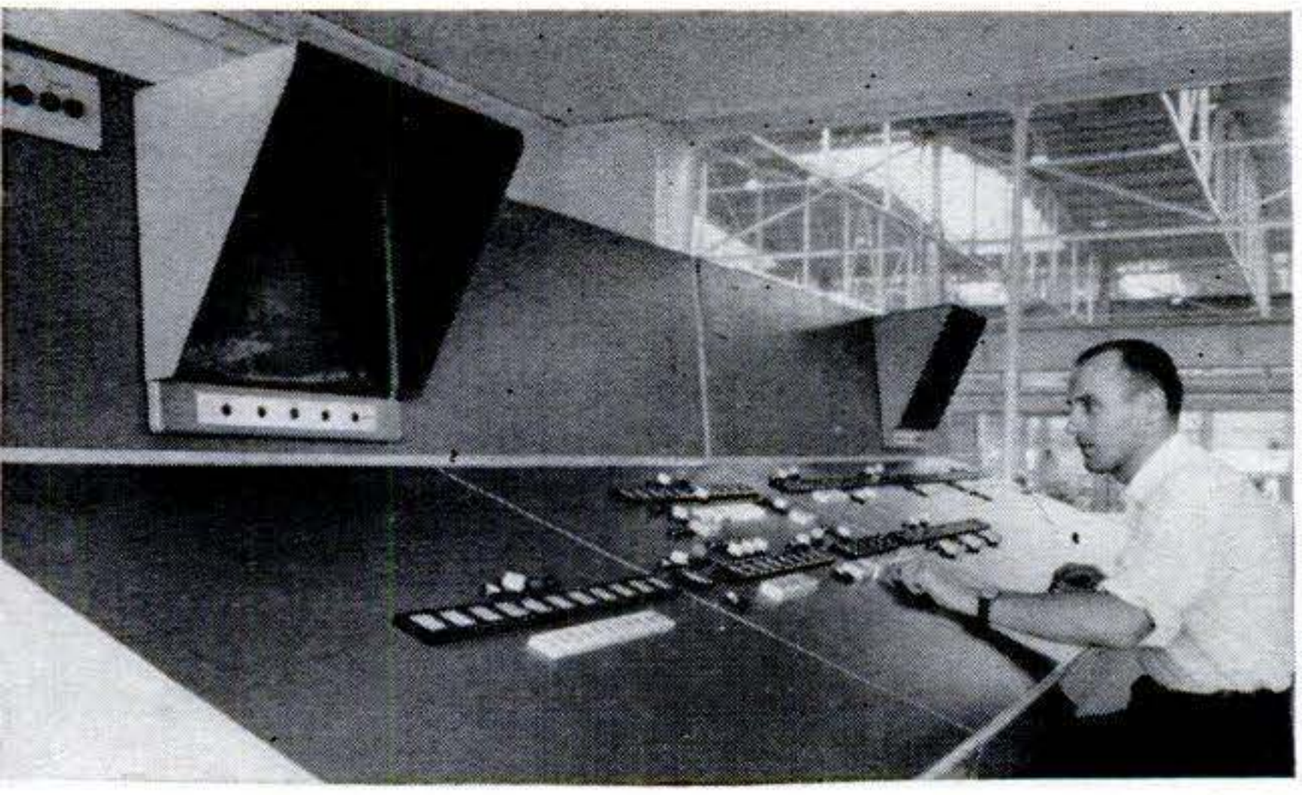


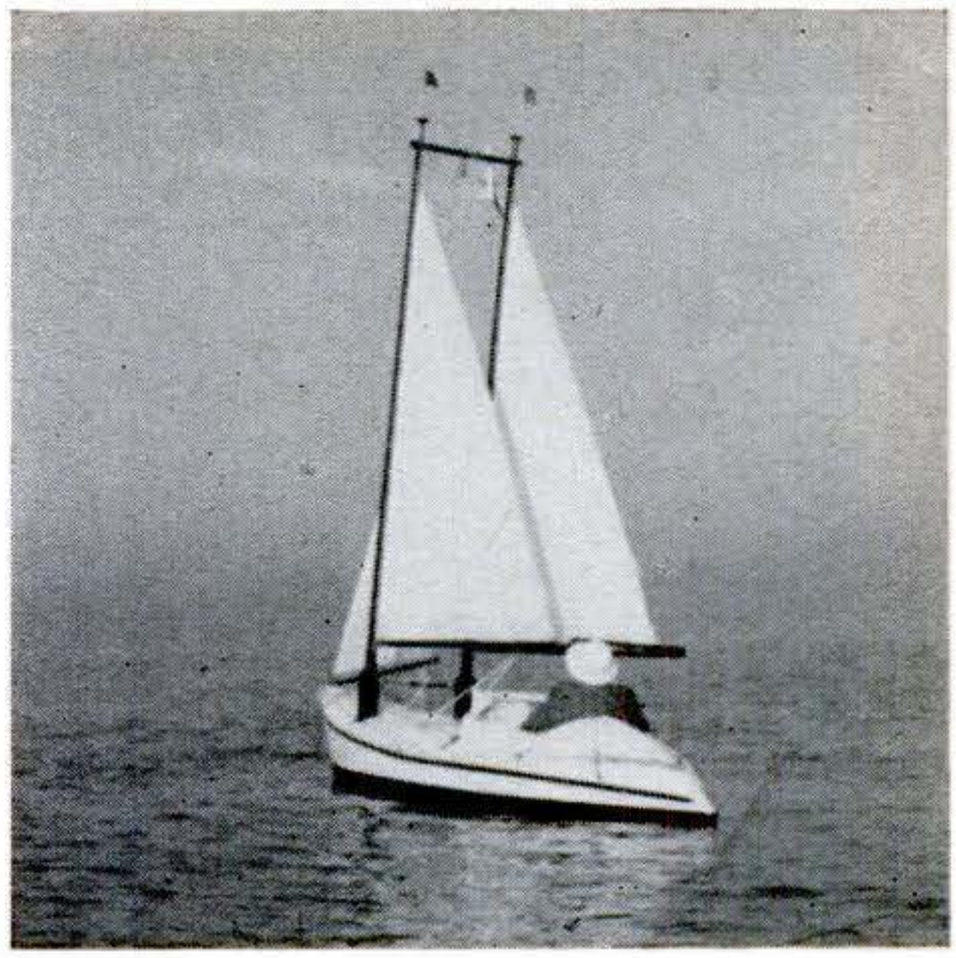


folding, and elevating doors. Installation of the engine and internal fittings starts immediately; other sections follow and are joined and pushed out the same way. When the bow is finally added and the hull entirely in the open, the gates are closed and the dock flooded to float the ship.

The shipyard cost $40,000,000 and took four years to complete. It can turn out a 40,000-ton vessel in only 20 weeks and can build supertankers up to 150,000 tons.

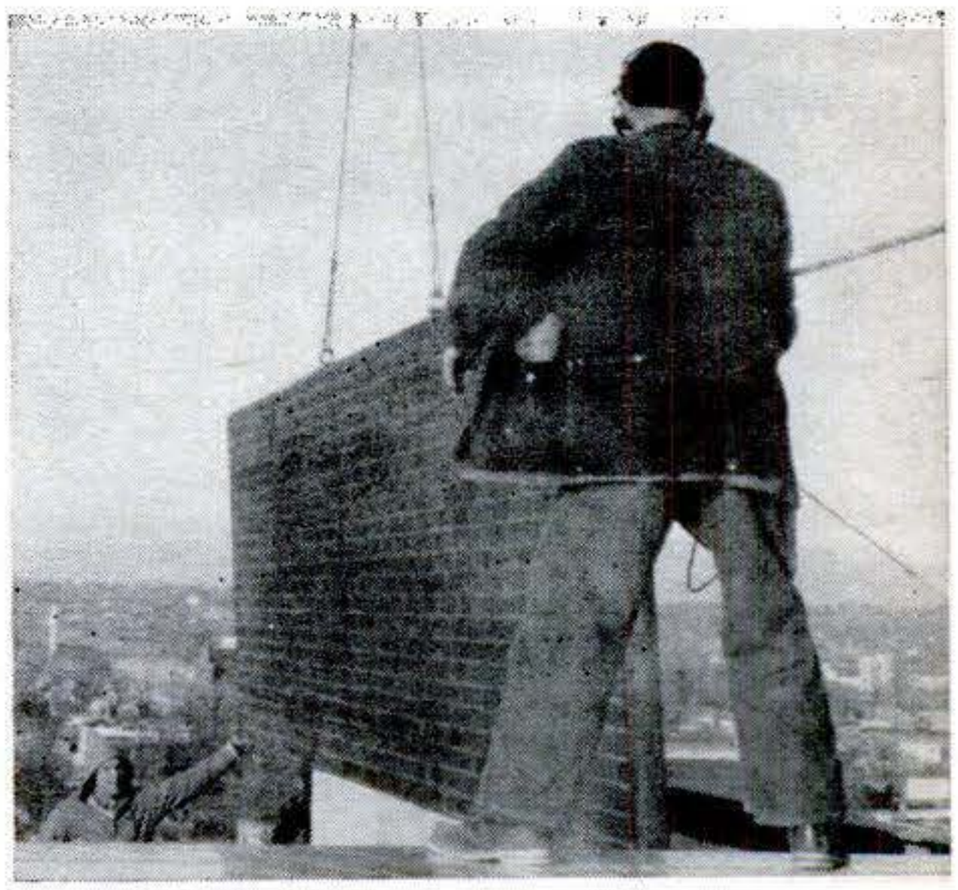


Automation nerve center controls conveyor-belt system. Steps are checked by TV, phone, radio.



Twin sails make own wind

Parallel mainsails on the 15-foot British boat above were designed and patented by a retired Welsh naval commander. The two masts are half the usual height, and the booms are linked by a crossbar. They apply a chimney effect to create a draft. Commander Guy Bagot can keep his craft moving when others are becalmed.



Prefabricated brick walls

A new mortar containing plastic lets builders bond bricks together into panels that can be lifted into place in any weather. Panels were braced in steel frames 4 by 5 to 4 by 14 feet, raised to the roof of an eight-story Denver building, and welded to become penthouse walls.

The extra-strength mortar was made from cement, sand, and Sarabond liquid polymer, a Dow Chemical development that may be on the market next year.

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Today's powerful medicines have saved many lives.

Wonder Drugs— Cure or....?

Nearly out. Coach Leo Durocher

By Lawrence Galton

CAN any drug be 100-percent safe? Here's a hard look at what scientists have been finding out about drug side effects—why they occur and for whom; what the new drug-regulatory laws will do; and what you need to know to protect yourself and your family.

How common are undesirable reactions to drugs?

Nobody knows for sure. One indication: One out of every 20 patients admitted to a large New York City hospital was there because of adverse reactions to treatment, according to a report in the American Medical Association *Journal.*

But many people experience less severe reactions and don't require hospitalization.

Have all drugs been to blame for side effects?

Every drug in use today or in the past has produced side reactions in one form or another, according to Dr. Frank J. Heck of the Mayo Clinic.

Says Dr. Walter Modell of Cornell Medical College: "No drug, no matter how tested by time or trial, is absolutely safe. Serious reactions occur with all therapies . . . the useful as well as the useless, the old as well as the new, the folk remedy as well as the modern miracle drug."

Even aspirin, one of the most widely used of all drugs, causes stomach irritation and bleeding in some people, asthma in some others.

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But they've endangered—and taken—others

almost died at Polo Grounds after penicillin shot. A doctor in the crowd saved his life.

Are newer drugs more likely to trigger reactions?

Yes, because of their potency. Old drugs had less strength, less effectiveness. They were weak, but at least they were fairly safe to use.

Modern drug technology began in the Thirties with the sulfas—the first compounds that could actually attack disease germs and knock out grave infections in a few hours. But they sometimes produced skin rashes, sometimes crystals in the kidneys.

Today's drugs are remarkably powerful. Some can stop blood from clotting, others can reshuffle body chemistry, bar worry, change personality, prevent pregnancy, slow down or speed up heartbeat. They're valuable, often life-saving, but they also entail risk—even, occasionally, the risk of death.

Many of the old-time drugs were weak. They didn't do much good, but they seldom hurt you.

What are the most common drug reactions?

Intestinal upsets from taking antibiotics are probably the most frequent. If you take an antibiotic by mouth it goes through the intestinal tract and then the blood carries it to the site of infection. While the drug is in the gut it may kill off some beneficial bacteria—ones that manufacture vitamins and that help, too, to crowd out disease organisms. If enough are killed off, yeasts, fungi, and other trouble-makers can multiply. The result can be nausea, vomiting, cramps, diarrhea, sometimes a maddening itch.

CONTINUED

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To prevent this, some physicians recommend that patients taking antibiotics also take buttermilk, acidophilus milk, or yogurt, which contain some bacteria of the beneficial kind normally present in the intestines.

Allergic reactions are common, too. About 10 percent of all people are prone to become sensitive to something or other. For some, this means that after having been helped by a drug once or twice they become allergic to it. Next time they take the medication, there's trouble. Mostly it's relatively mild—a rash, or bumps (hives) on the skin, or some fever. If the drug is stopped the reaction usually goes away by itself. In more severe cases, a cortisone-like hormone may be used to suppress it.

As a safeguard against unexpected reactions, your doctor may ask you to wait in his office for 20 minutes after taking a drug.

Occasionally, however, an allergic reaction can be life-threatening. One night last year, in a locker room at New York's Polo Grounds, Los Angeles Dodger coach Leo Durocher got a shot of penicillin for a minor infection. Fifteen minutes later he felt dizzy and staggered into the trainer's room, moaning, "I'm going, I'm going," and collapsed.

It took an intravenous shot of adrenalin, two shots of antihistamines, plus oxygen hastily administered by a physician called out of the stands to save his life.

Many physicians now make skin tests for sensitivity before injecting penicillin and other known allergy-producing drugs. As an extra precaution they may also keep patients in the office for 20 minutes or so after injections so that prompt treatment can be given if necessary.

Allergic reactions are less likely with newer penicillins that can be taken by mouth. And they are relatively rare with other oral antibiotics. But no drug yet known can be guaranteed not to produce allergy in someone. Some diabetics have become allergic to insulin. And some people even become allergic to antihistamines—drugs meant to relieve allergies.

Can a really safe-and-potent drug be made?

Probably not. Unlike a well-aimed rifle bullet, a drug rarely hits only the bull's-eye. This isn't always bad. For example, aspirin, aimed at reducing pain and fever, also lowers blood sugar in diabetics—something that may be desirable.

But other side effects are not so benign: Potent tranquilizing agents, such as chlorpromazine, for example, have helped thousands to leave mental hospitals. But they've also produced shaking palsy.

One high-blood-pressure drug, hydralazine, sometimes causes arthritis-like symptoms. Another, reserpine, makes some people's noses clog.

Cortisone-like hormones, valuable for arthritis, asthma, kidney and many other troubles, are blamed for occasional cases of peptic ulcers.

Chloramphenicol, a potent antibiotic, sometimes produces

[Continued on page 198]

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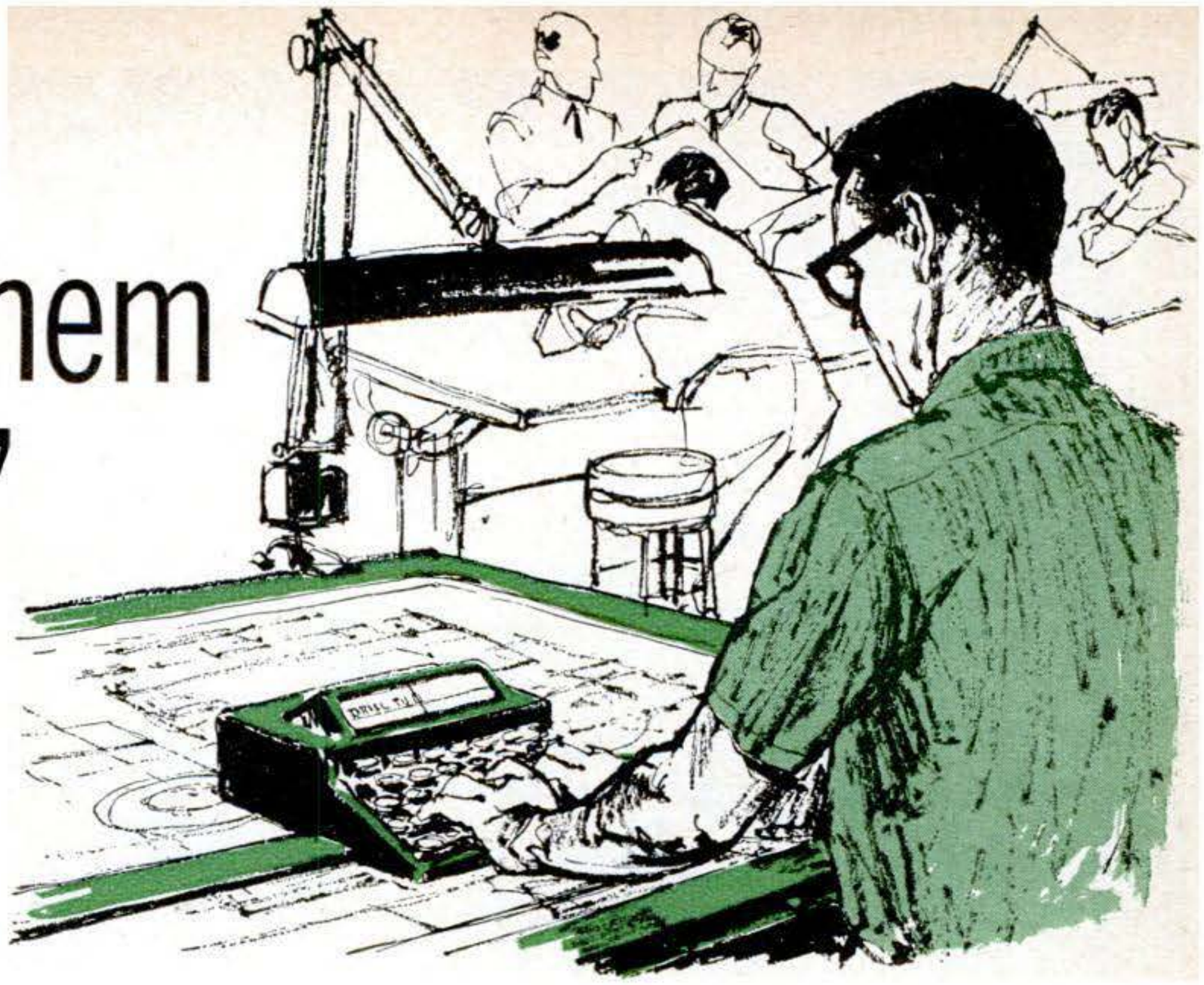
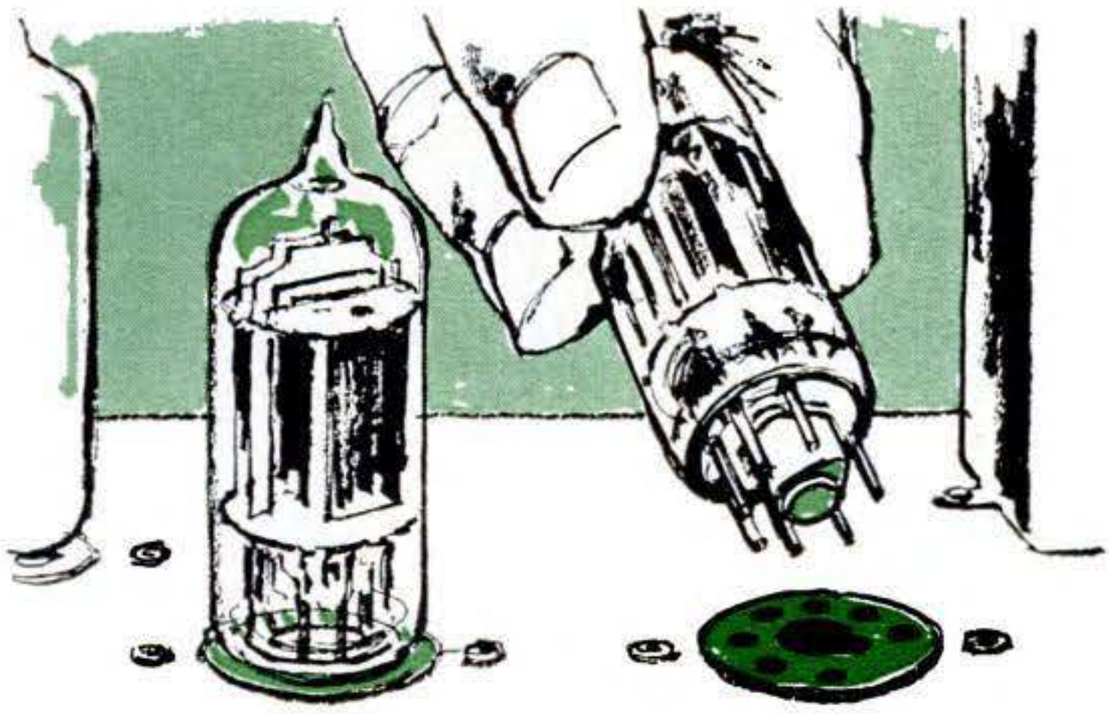
"I'd like to see them make..."



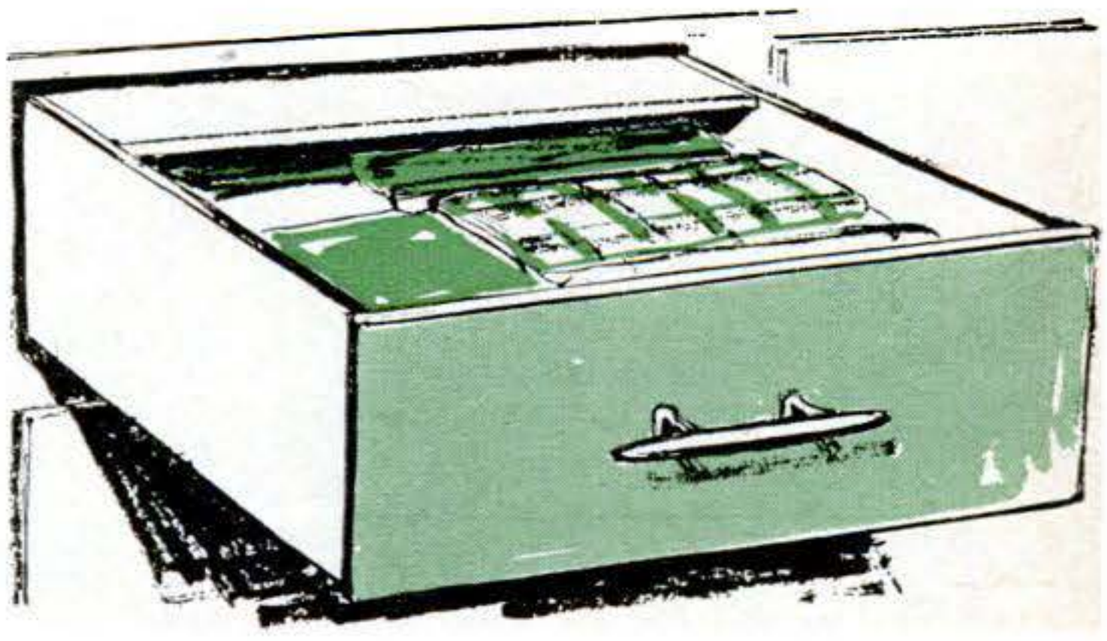
A no-platen typewriter for draftsmen that would roll on a drawing board. It would eliminate the printing of labels and instructions on drawings and blueprints.—*J. A. Defrees, Durhamville, N.Y.*



Miniature TV tubes with a pilot at base and at socket so you could tell when to press them in safely. They're devils when you can't see their sockets.—*P. Legon, Malden, Mass.*

An air check on the hood of a car. We need some device to prevent filling station attendants from whamming it down so hard they chip the paint.—*Ellis Thompson, Candler, N.C.*

Bricks with one rounded face for paving walks. Smoothly curved edges and corners wouldn't snag a snow shovel and there'd be less chipping of bricks.—*Gary A. Larson, Kane, Pa.*



Jam-proof drawers in built-ins and furniture. A strip of wood across the top at the rear would keep things from spilling out over the back.—*Mrs. J. Shuppert, West Acton, Mass.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

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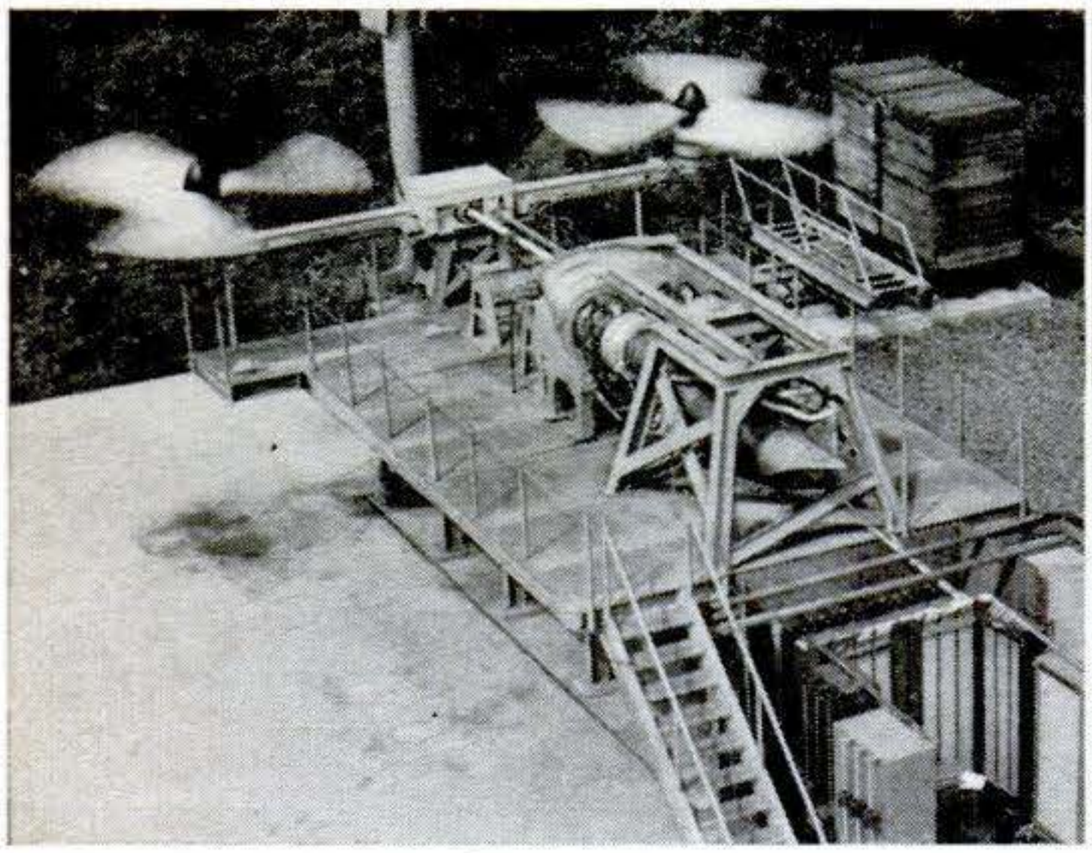
No mudders wanted on this synthetic racetrack

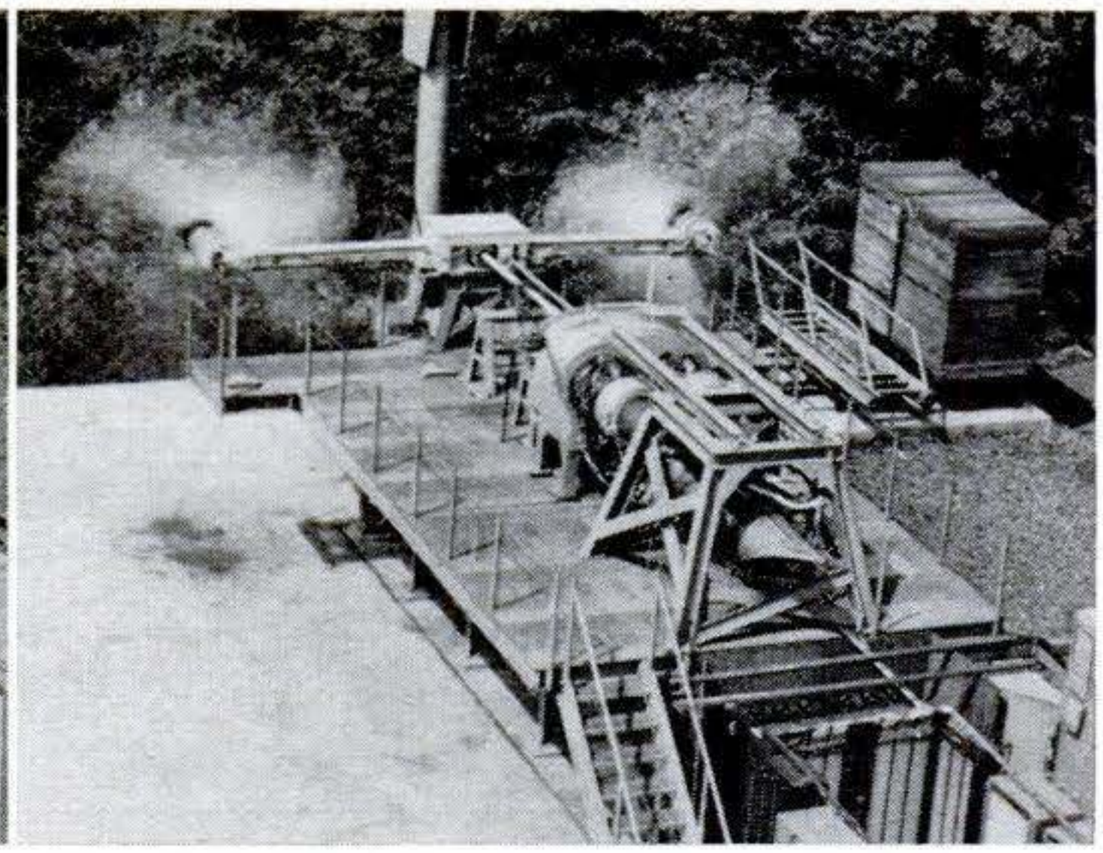
It's always fast on a new harness track at Washington, Pa.—in fact, faster by a second or two than the hardest dirt. Some $700,000 of the track's $5,000,000 cost went for surfacing the ⅝-mile oval with a synthetic-resin mix developed by Minnesota Mining & Mfg. Co. The all-weather, nonslip topping, called Tartan, was poured ⅝ to an inch thick on an asphalt base. It sets in 10 to 15 minutes, is resilient, needs little maintenance. Three-M says it's good for foot racing, as well as horse tracks, playgrounds, football fields, barn floors, and airplane runways.

Vertical-takeoff plane zooms to 460 m.p.h.

Fastest so far of the VTOLs is the Curtiss-Wright X-19, built under a joint Air Force, Army, and Navy program. The plane takes off, hovers, and lands like a helicopter, with props pointed straight up—swings them 90 degrees for horizontal flight. It's powered by two 2,200-hp. Lycoming turboprop engines in the rear of the fuselage, so geared that in case one fails the other can drive the propellers. At 460-m.p.h., it's nearly 300 m.p.h. faster than most helicopters.



Props on test stand are in takeoff position. Engine is in foreground on bed of stand.



Swung horizontal, props operate here in cruise position. They can be tilted to any angle.

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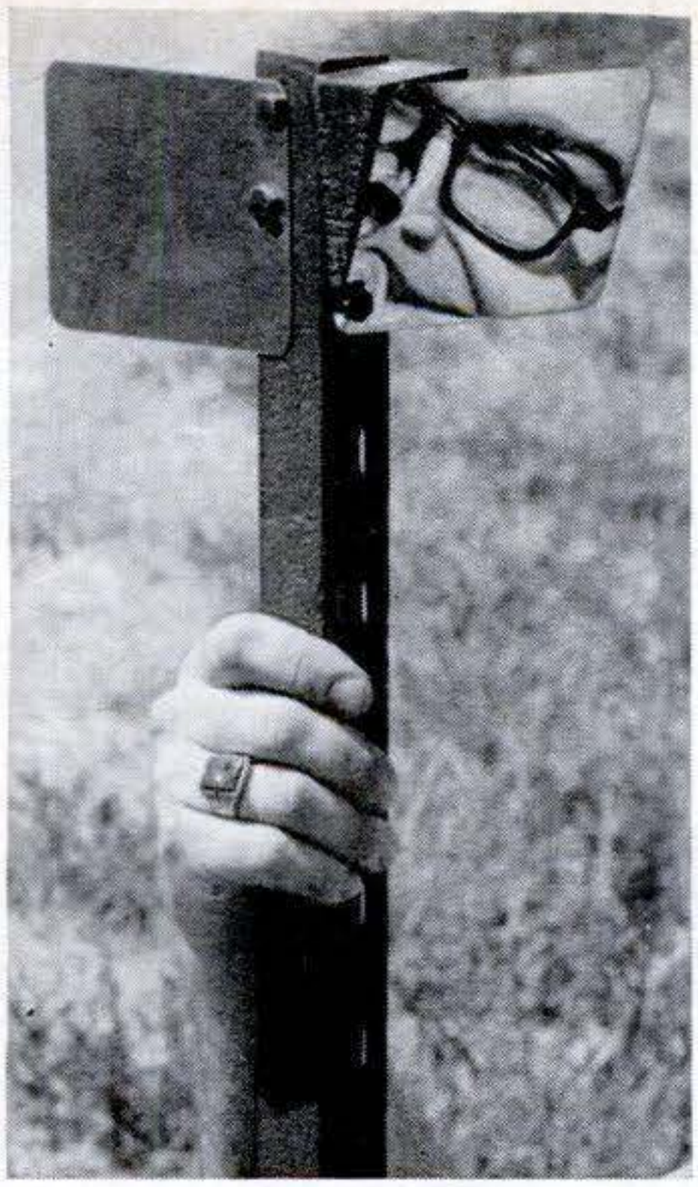
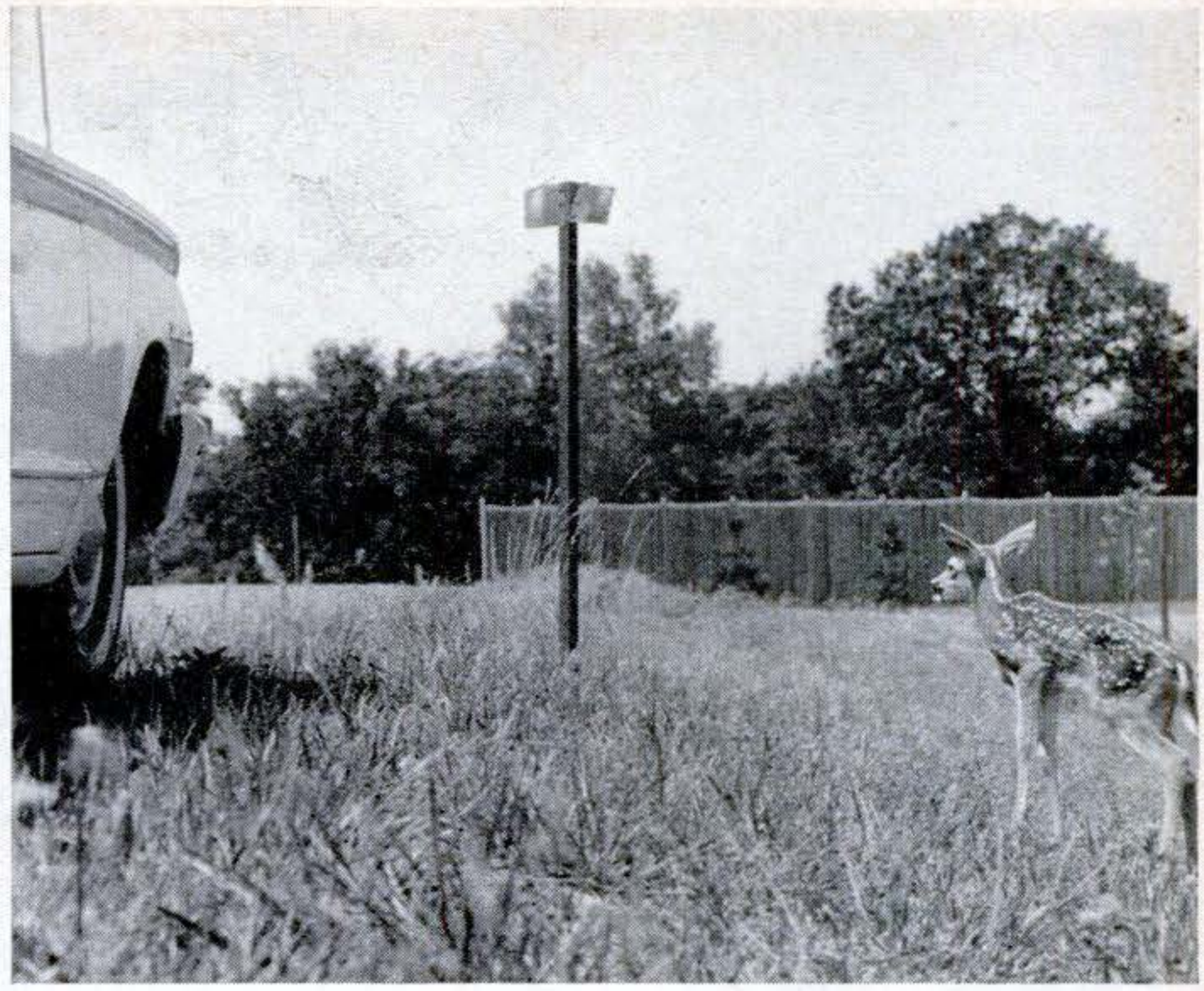
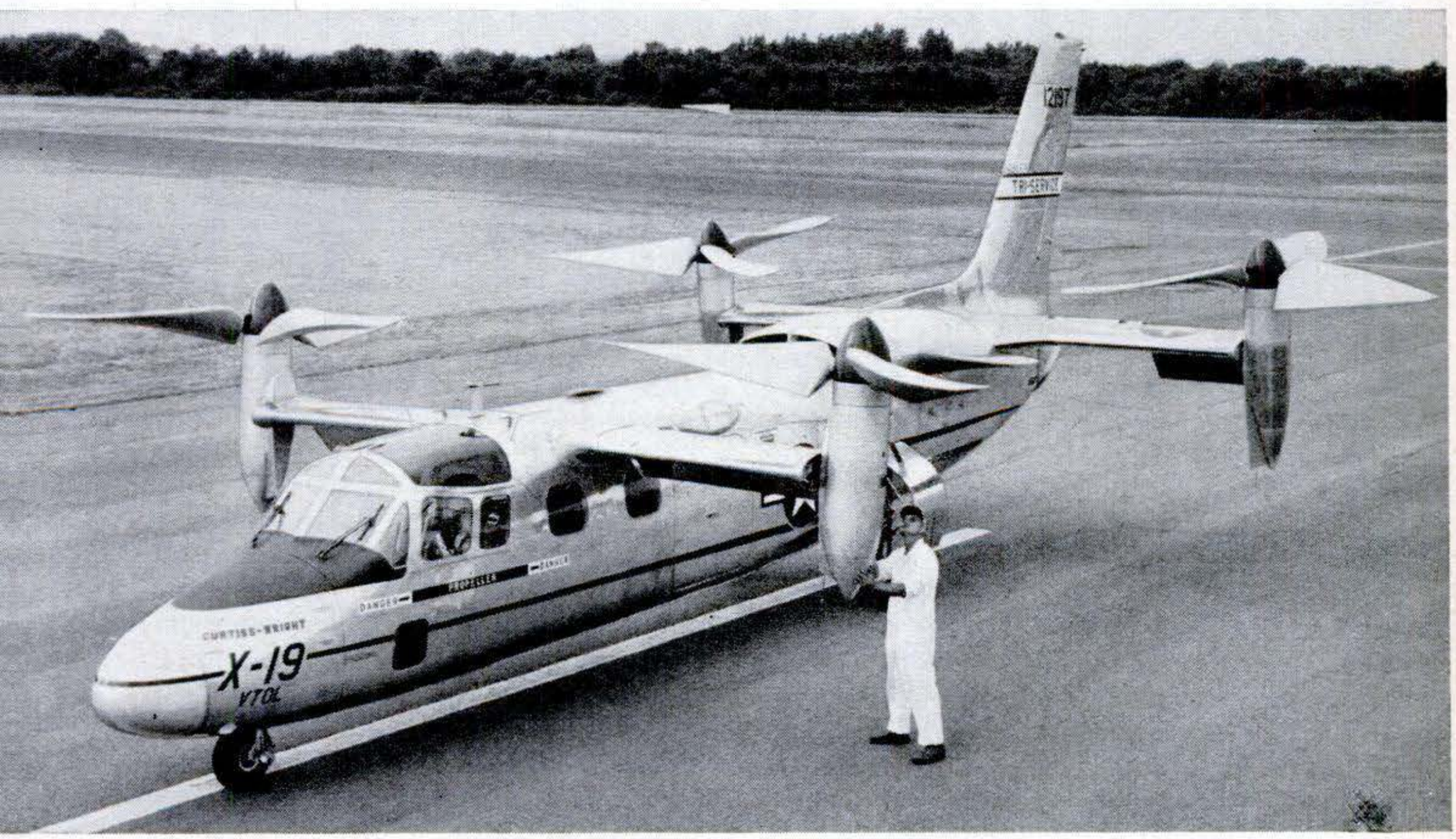




Stop-and-go lights keep deer off highway

Mirrors installed at deer crossings on Iowa highways reflect the headlights of approaching cars at night, mesmerize the animals temporarily, and keep them from darting onto the road. Last year, before their installation by the state's Conservation Commission, 726 deer were killed in traffic, an all-time high. The mirrors are stainless-steel reflectors on angle-iron fence posts set in road shoulders. They reflect the beam into a deer's eyes, but not back into the motorist's. Up to now, 21 have been erected at two deer crossings, and have been successful.



Tilting-prop X-19 can take off without runway, like a helicopter, cruise at almost jet speed.

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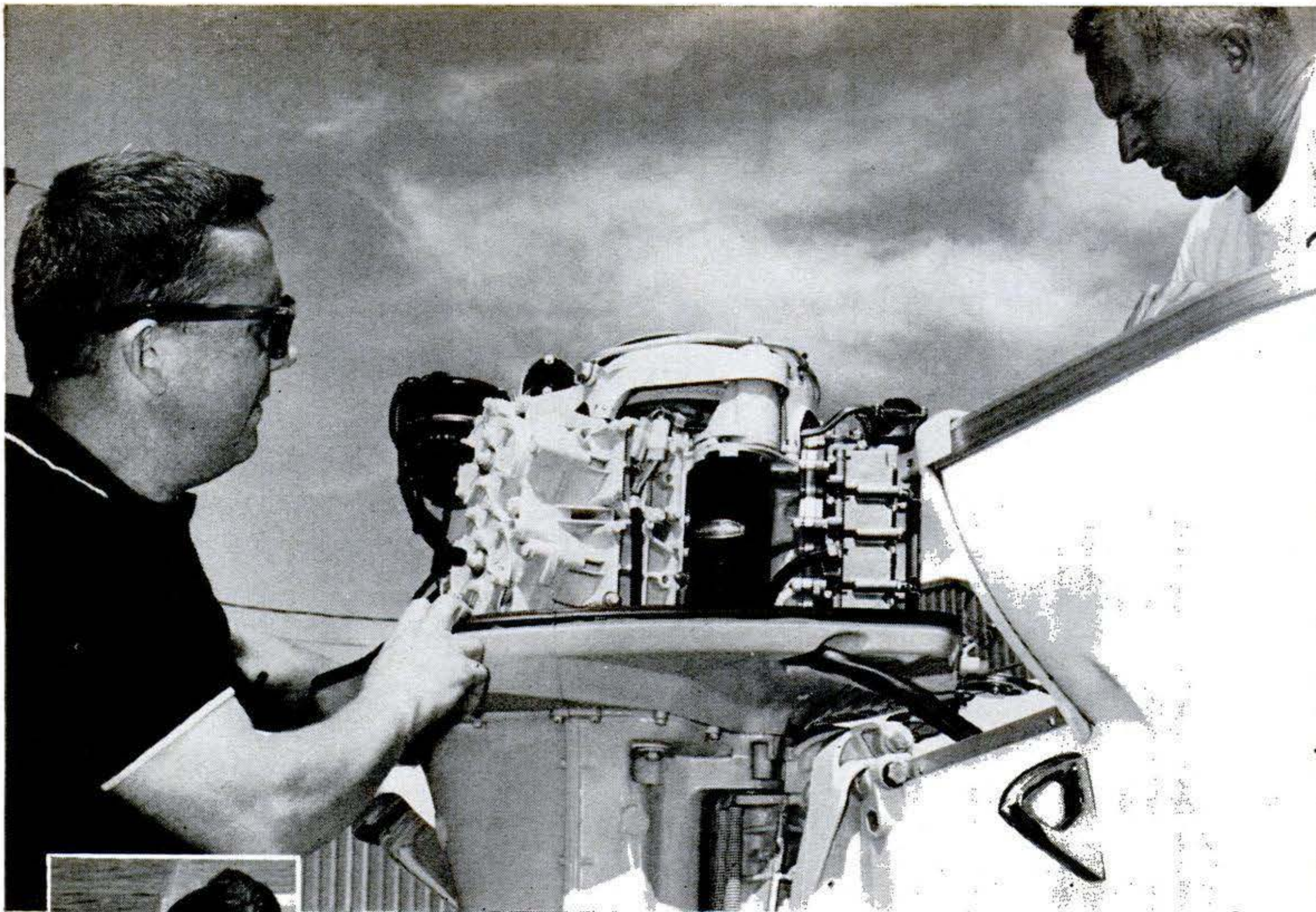

Johnson's new 90-hp. Meteor has a four-barrel carburetor (see right).

Jim Roe Pre-Tests the '64 Outboards

Prediction: You'll want one!

By Jim Roe

YOU'LL *like* the '64 outboard motors, now beginning to move into dealers' showrooms. I have personally tested most of them, sometimes operating first-of-the-breed models even before the finishing-touch nameplates were in place.

Here's the big news:

- Bigger motors. Johnson and Evinrude are each introducing brand-new 90-hp. models. For each company, that's 15 more horses than the 1963 top of 75 hp.
- Smaller motors. Mercury has designed a rugged and simple little one-cylinder 3.9-hp. fisherman. And several other companies have redesigned their low-power fishing motors for a low silhouette and lighter weight.
- Two-cylinder 50-hp. motors, with 25 horses from each cylinder! You get it from West Bend and Montgomery Ward motors.
- New gas-oil ratio. You'll use half as

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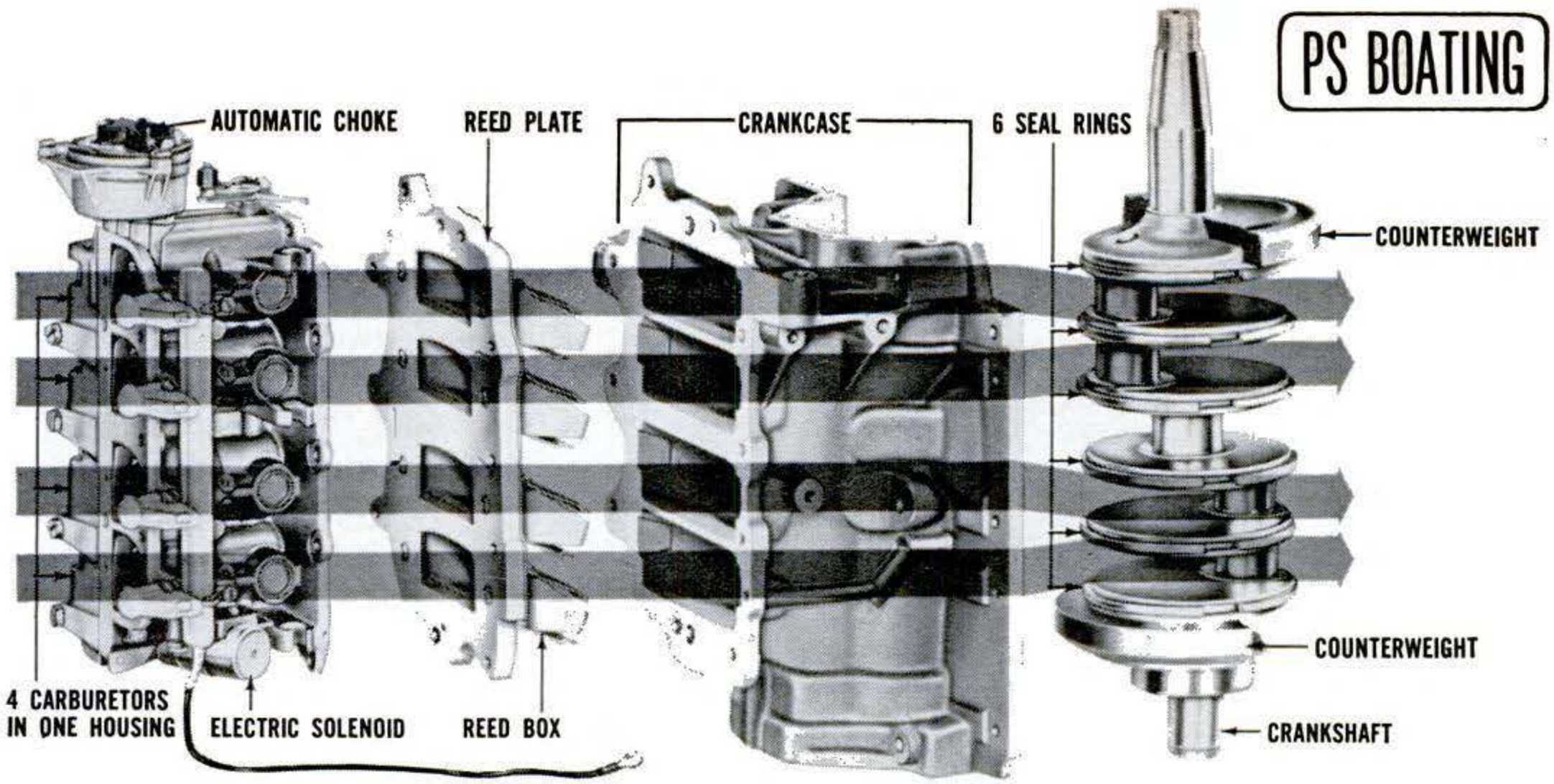
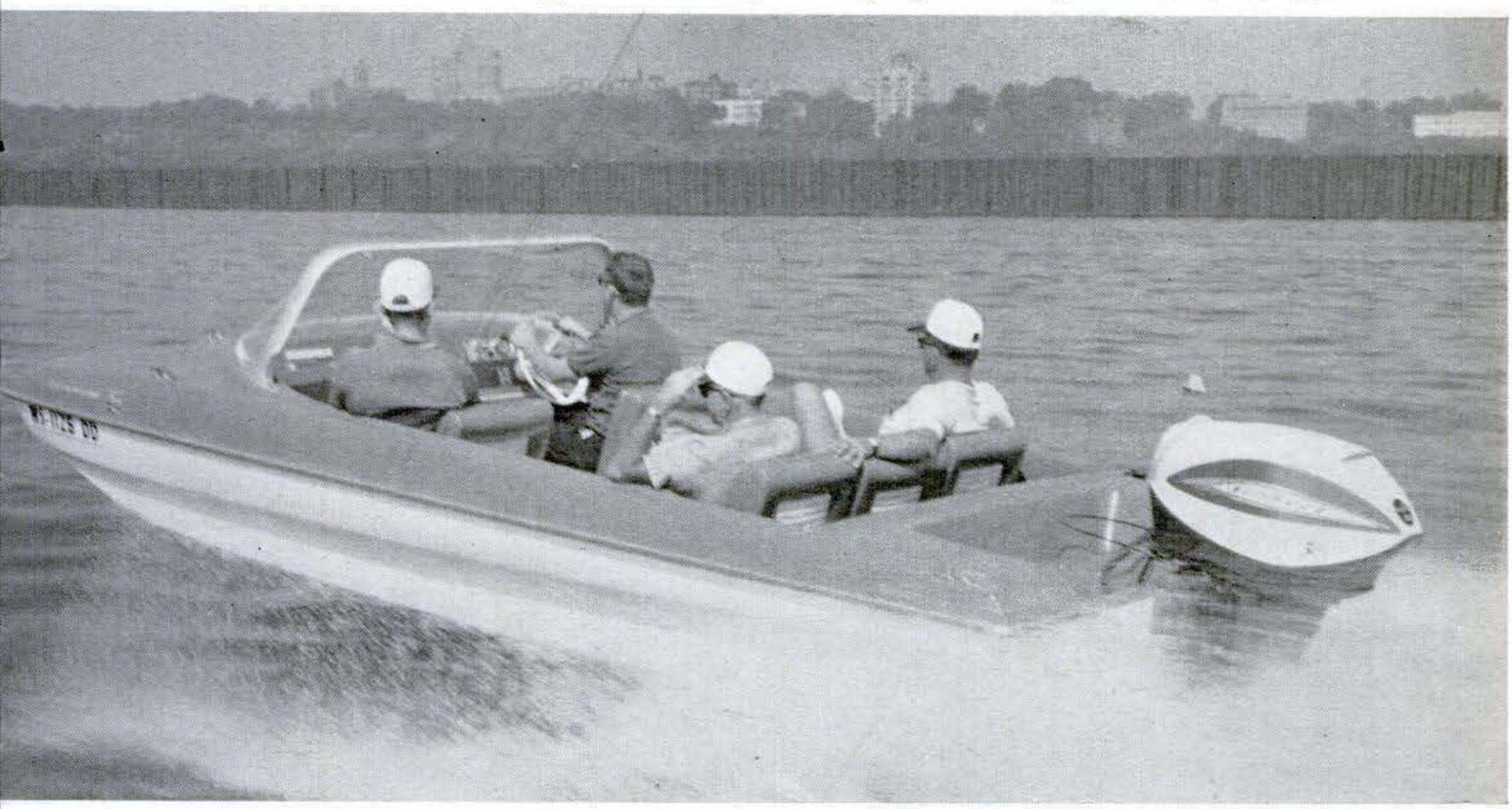


Induction system on Outboard Marine's new 90-hp. motors (Evinrude, Johnson) starts with four carburetors in one housing. There's a sloped reed box for each cylinder. Six seal rings keep each crankcase as small as possible. Carbs have "ganged" low-speed needle valves.



Evinrude not only has new 90-hp. model 90S, but also a new gullwing-hull fiberglass boat for 1964.

much oil as before in both Johnson and Evinrude motors for 1964. Each has announced a 50:1 ratio, replacing what has been a standard 24:1.

- More models. Name the exact horsepower you want—and chances are there's a motor available. Several of the manufacturers have added models to fill in gaps.
- Wider price range. These new motors make it easy for anyone to get started in outboard boating.

Prices on the 1964 models will range from about $165 for the fishermen group up to nearly $1,400 for the biggest team of horses packed into any production outboard. And even the smallest rig you might wish to buy has full forward-neutral-reverse gearshift, easy starting, and a rugged "don't-worry-about-me" reliability that adds to the pleasure of outboarding.

Now turn the page and read in detail what I found out about each of the makes.

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West Bend gets 50 hp. from two cylinders

West Bend for 1964 has come up with the first two-cylinder 50-hp. motor. This Golden Shark "500," firmly clamped to the transom of Glastron's 13½-foot Jet Flite, sped me along at nearly 40 m.p.h. And on Traveler's 16-foot Centaur we went only a few miles slower.

The motor kicks out an amazing 25 hp. per cylinder at 4,750 r.p.m. It weighs in at 142 pounds, has an electric starter and a three-phase alternator-generator. Bore and stroke: 3.2″-by-2.8″. It's also available with a magneto.

There are three other new West Bend motors for 1964. Two of these are in the moderate-horsepower range—6 and 10 hp.—designed as carry-along motors. The other newcomer is a 35-hp. Golden Shark "350" in a modest price range.

Top of the line is the big 80-hp. Tiger Shark, which shot me along a test course in a 17-foot Carver lapstrake hull. Improvements have been made for 1964 in the Tiger Shark's reverse tilt, and in its steering and shock systems. It's a lot of motor in anyone's league.

West Bend's 500 is first two-cylinder motor of 50 hp. Its "v-reed" valves create supercharged effect by providing a high-velocity fuel-air mixture. Other models turn out 80, 35, 20, 10, 6, and 3½ hp. Most have "acoustical leg."

Montgomery Ward will offer hp. ratings from 3½ to 80 in 1964. Test motor shown is new 50-hp. two-cylinder job. Cylinders have 3³⁄₁₆″ bore, 2.8″ stroke. Carburetor is fixed high-speed jet, with electric choke at control station.

Newest Mercury is the smallest

In 1964 Mercury has the widest range of horsepower ever offered in the outboard industry (nine models from 3.9 to 100 hp.) and four choices in number of cylinders.

Newest is the one-cylinder Merc 39. It packs 3.9 willing horses in a lightweight, quiet-operating package. Bore is 2″, stroke 1¾″. It has propeller-hub exhaust so you can smell the cool breezes—not exhaust gases—as you troll.

I tested the Merc 39 on a 13-foot Starcraft pram, and it hustled me right along. It's a handy package for fishing or for use as a sailboat auxiliary.

We clamped a new Merc 200 (two cylinders, 20 hp.) on the transom of a Silver Line 13-foot Maverick, and the combination checked out at a top of 24.4 m.p.h. The Merc 200 has been completely restyled to match the design of the other Glide-Angle

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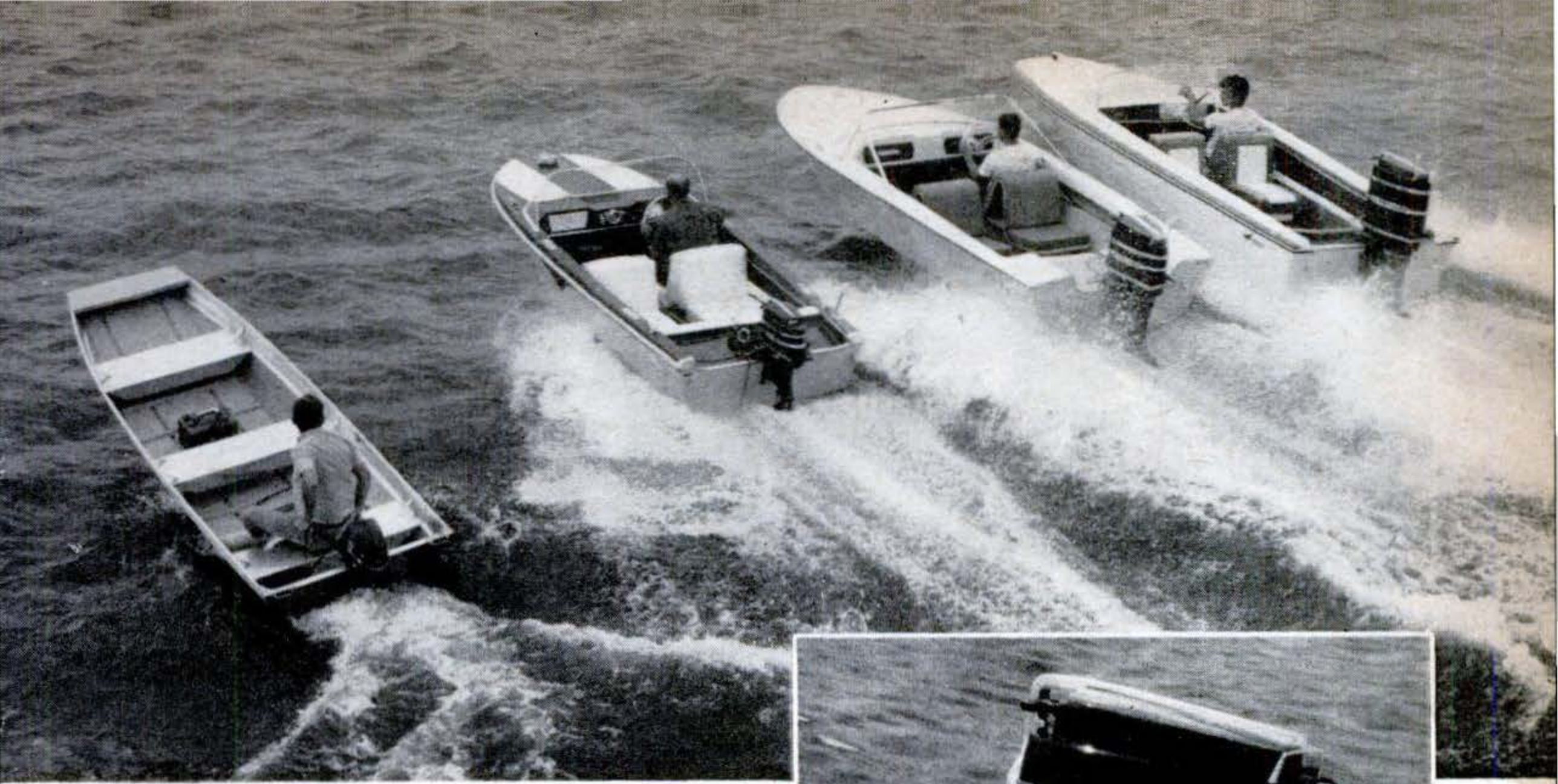

Mercury has widest choice of cylinders. Here author runs new one-cylinder in far-left boat. Other three boats carry two-, four-, six-cylinder jobs. The horsepower range: 3.9 to 100.

fishing twins. It's all black and more compact than the 1963 model. Its design permits a heavy-duty gear setup to handle all its power without straining the engine.

A Merc 650, its four cylinders and 65 hp. pushing Lone Star's fine Triton 15-footer, moved along at a top of 35.8 m.p.h. The 650 is the most powerful "four" Mercury has ever made. It has full electric starting, plus automatic rewind and a special aircraft-type magneto for a high-energy spark. Its new balanced manifold gives superior idling and reduces air-intake noise.

The big black Merc 1000, on Traveler's 15-foot Centaur, delivered 40.4 m.p.h. The 1000, a 100-hp. six-cylinder in-line motor, continues to be hailed as the world's most powerful production outboard.

Besides the four models I tested, Mercury's 1964 line includes a 6-hp. Merc 60, a 9.8-hp. Merc 110, the 35-hp. Merc 350, the 50-hp. Merc 500, and an 85-hp. Merc 850. All are black with silver trim.

World's most powerful production outboard is Merc 1000, a full 100 hp. of get-up-and-go that pushed Traveler's 15-foot Centaur along trial course at 40.4 m.p.h. Exhaust is under water.

Johnson—new horsepowers

I gave the new 90-hp. Meteor a real workout. I tested it on a 17-foot OMC, a 16-foot Sea Ray, and Lone Star's brawny new 17-foot Chesapeake. Johnson engineers have done quite a job of packing 90 horses into a four-cylinder motor with a 3⅜″ bore and 2½″ stroke. They say the Meteor uses no more fuel than outboards 16 percent smaller. And like every engine in Johnson's 1964 line, the Meteor uses a fuel-oil mixture at a 50:1 ratio instead of 24:1.

The Meteor has a V block, and a new power head with the first *four*-barrel carburetor in outboard history. Four separate carburetors in one housing—with a "straight-in" induction system—furnish equal fuel to each cylinder. In effect, this gives you four separate motors. A six-seal crankshaft com-

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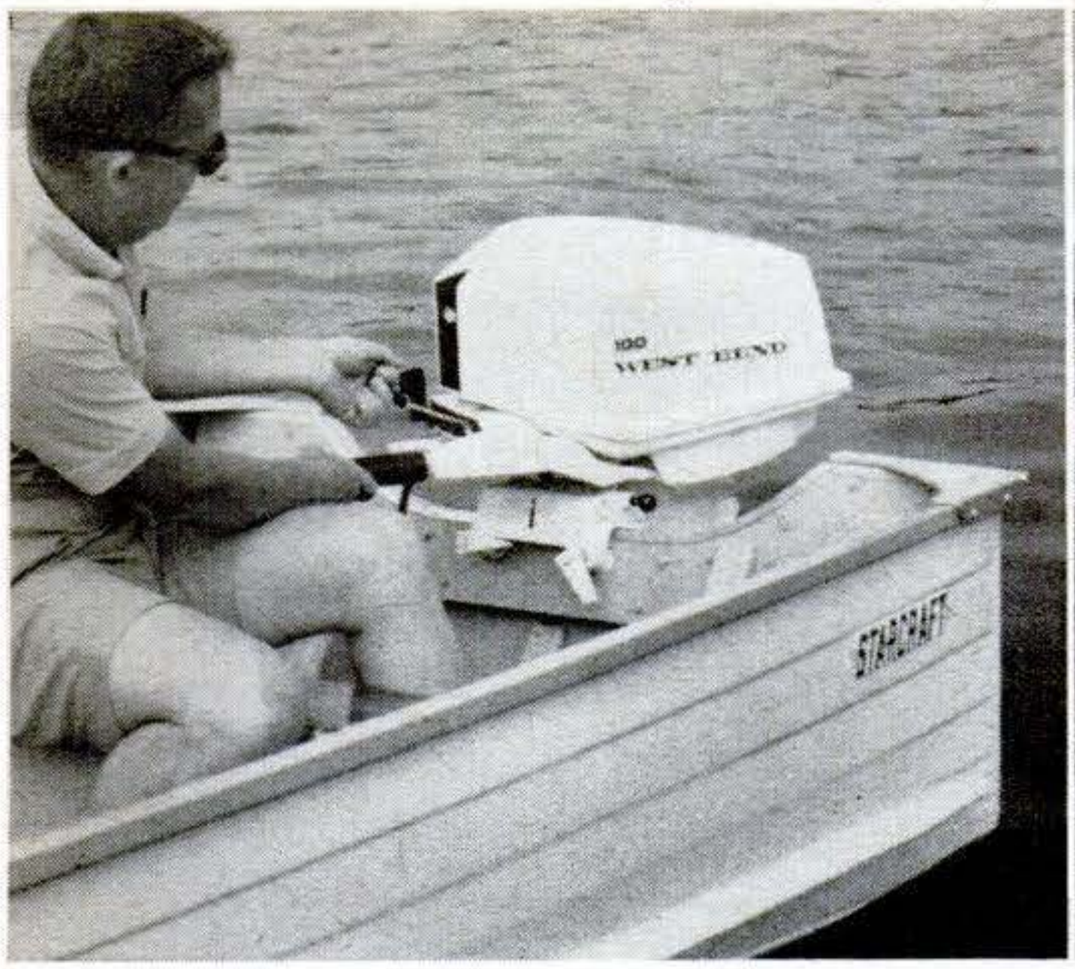
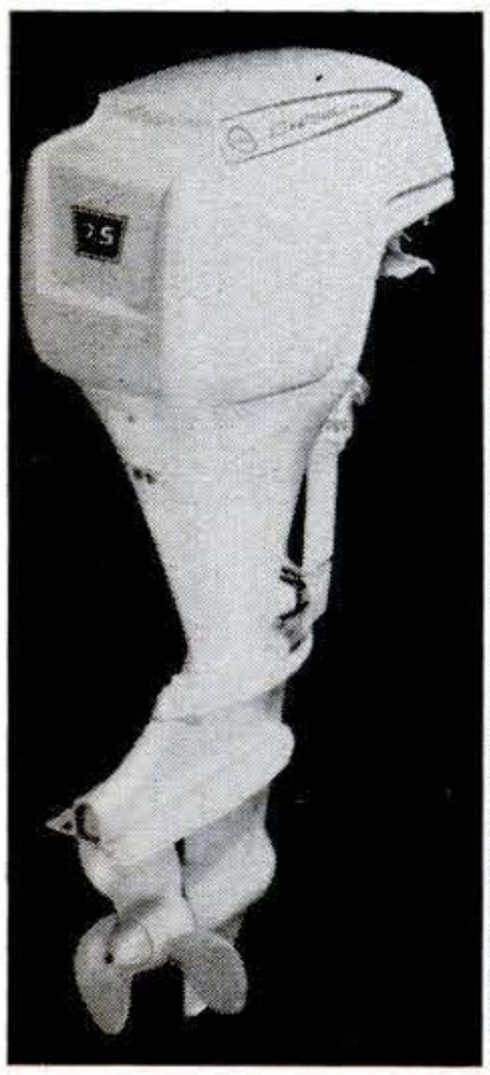
Fishermen! These lightweight power plants give speeds up to 25 m.p.h.,



New low-profile 10-hp. Shark "100" by West Bend is quite a whiz. It easily pushed a boat at nearly 25 m.p.h. It weighs only 68 lb., has magneto ignition, rewind starter, a full gearshift.

One-lung Merc 39 packs 3.9 hp. One-piece lower unit has a swept-back design to slide past lily pads without snagging. Motor has full gearshift, no shear pin, resilient rubber suspension.



For fishermen, there's a Sears, Roebuck (left), a McCulloch (right). Sears's Ted Williams "twins" come at 7½ and 9½ hp. The McCulloch 9½ hp. (and all other McCulloch motors except the 3½ hp.) comes equipped with a 300-gallon-an-hour Bail-a-Matic pump in lower housing.

pletes the individualizing of the cylinders. Leaf-valve plates slope downward to prevent raw fuel from puddling behind the leaves—which could cause coughing, sputtering, or spark-plug fouling.

The new Meteor has a new hot-air-actuated choke that gives smoother running during warmup. The Meteor also has a built-in alternator-generator, capable of charging 20 amps at only half throttle. A voltage regulator protects the battery.

A favorite of mine among the Johnson Sea Horses is the completely new 9½-hp. fisherman. I tested it on a 14-foot Duracraft, both in open water and in the assorted greenery along the shore. All controls are handily located on the front panel.

You can cast right over this little motor, for it's built with an exceptionally low profile—a full 8½" nearer the transom than last year's 10-hp. model. We spooked right along a shoreline so full of vegetation we seemed to be in someone's garden. This was to test the shallow-water drive of the 9½. The test was a success.

Johnson's third new engine is the V-60. I put this one through its tests on a 16-foot Cruisers, Inc., lapstrake boat. The V-60 was created for families seeking a powerful engine at a moderate price. The model I tested had ample power for skiers.

Johnson's smallest, the Sea Horse 3, is offered in two models for 1964. In addition to the Anglematic weed-resistant model, there is a new right-angle drive with 20 percent more thrust to aid a sailboat skipper using auxiliary power. The Sea Horse 3 is also available with a lower-unit extension, for use on sailboats with high transoms.

The total Johnson model lineup (including all the three new models I tested) includes horsepower ratings of 90, 75, 60, 40, 28, 18, 9½, 5½, and 3. The new 50:1 gas-oil ratios were established this year, say Johnson engineers, because of closer tolerances in manufacturing, and better materials in

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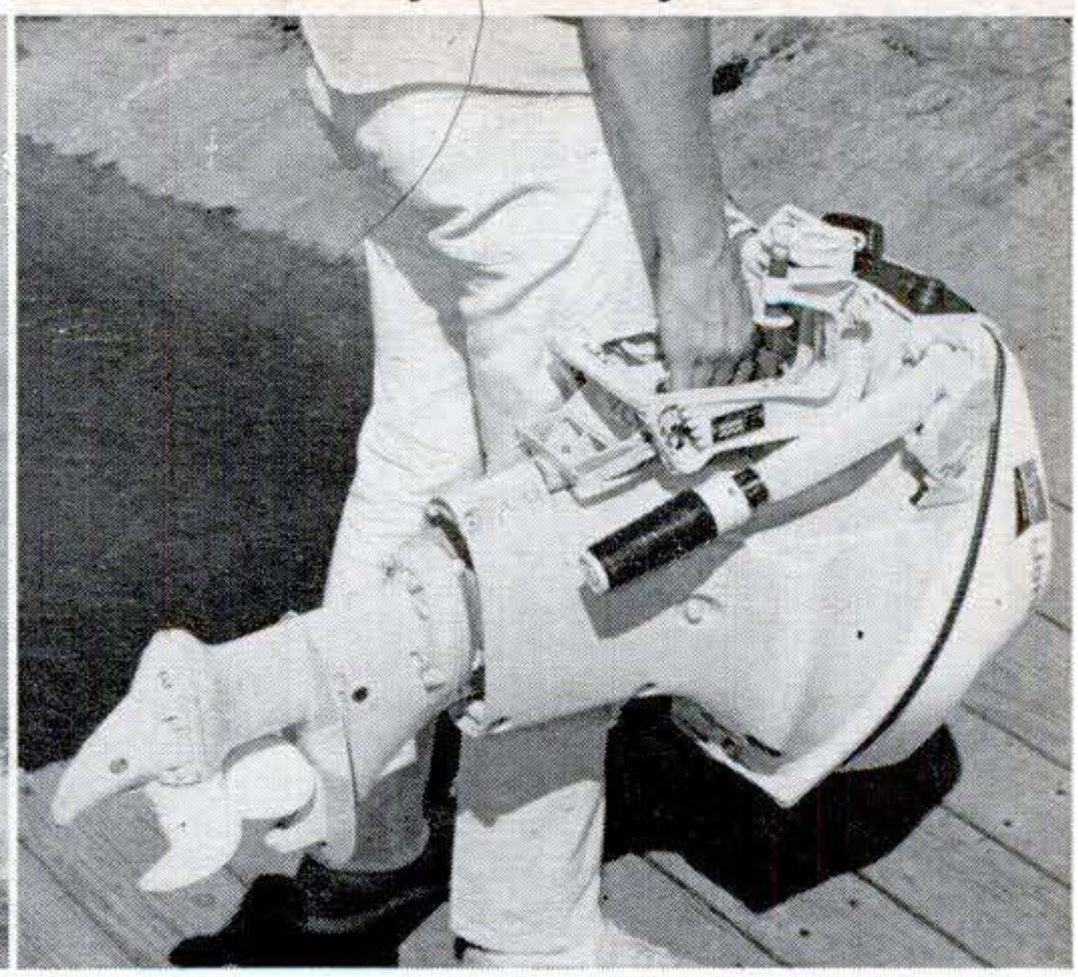
trot all day on little gas, operate in shallows, are easy to carry

Evinrude's 9½-hp. Sportwin has tilt-up mechanism for shallow water. It has down-draft carburetor with fixed high-speed jet, thermostat temperature control, new "down-hill" induction.



Johnson 9½-hp. fisherman's Sea Horse is ready to go wherever you are. A handy handle, no shin-barking projections make it highly portable. The low-profile motor weighs only 59 pounds.

critical areas. It applies to all Johnson motors, and makes fuel consumption more economical, exhaust gases less, spark-plug life longer. Any type of gasoline and oil—marine or automotive—may be used.

Testing two of Evinrude's 14 models for '64

I first took the big new 90S out into Lake Michigan on one of the aluminum test boats used by Evinrude engineers. A series of straight runs full-out, high-speed turns, and takeoffs from standing starts convinced me that there were indeed 90 horses behind me, even though they're housed in space that used to stable 75.

Perkins 40 hp. has electric starting, ignition noise suppressors as standard equipment.

This 90S has a modern power head of four-cylinder V design, short stroke. Metered fueling gives the engine fast and smooth acceleration or deceleration. Part of the high horsepower comes from the four-barrel carb.

This 90-horse team responds to the poke of your little finger. Evinrude's push-button electric shift turns the trick, with forward, neutral, and reverse easily selected by button position, without even looking.

After full operation of the test boat, I pulled alongside a boatload of Evinrude salesmen out for their first ride in Evinrude's own new 16-foot fiberglass boat. This boat, with a "gullwing" hull design, is a stable and steady craft, so I had no trouble climbing aboard. The trusting passengers stayed aboard and we were off to see the 90S at work on this new hull. This proved to be a near ideal boat-motor combination. Ninety hp. on a 16-foot boat is a lot of power, but the boat is built to handle it. The hull is a deep-V design, with the center portion flared out to form V-shaped sponsons on both sides.

At the other end of the scale from the big 90S, I took Evinrude's brand-new 9½-hp. Sportwin fisherman on a harbor tour, pushing an AlumaCraft fishing boat. The little motor, weighing in at only 59 pounds, standing shorter than a yardstick, acts like

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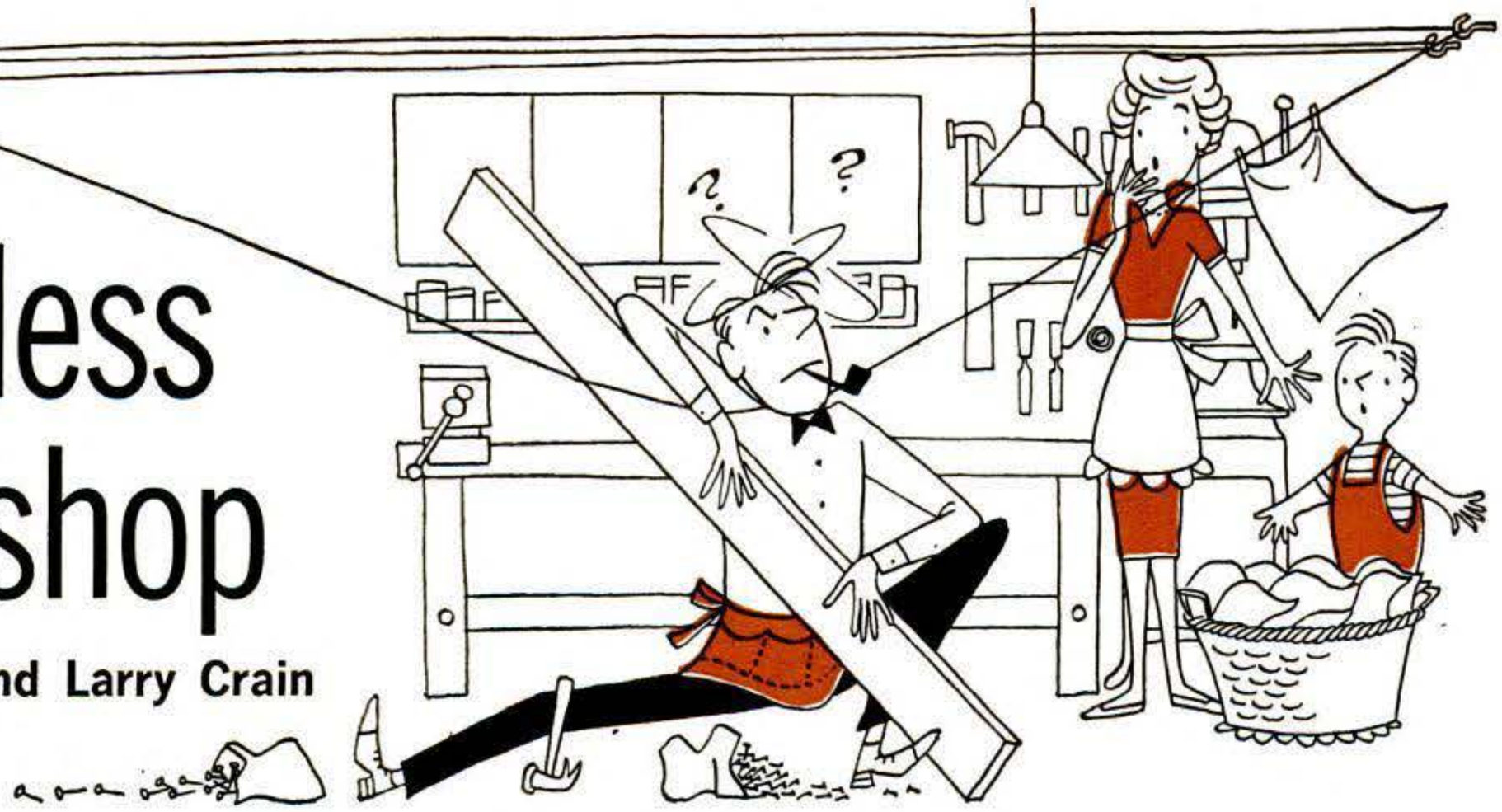
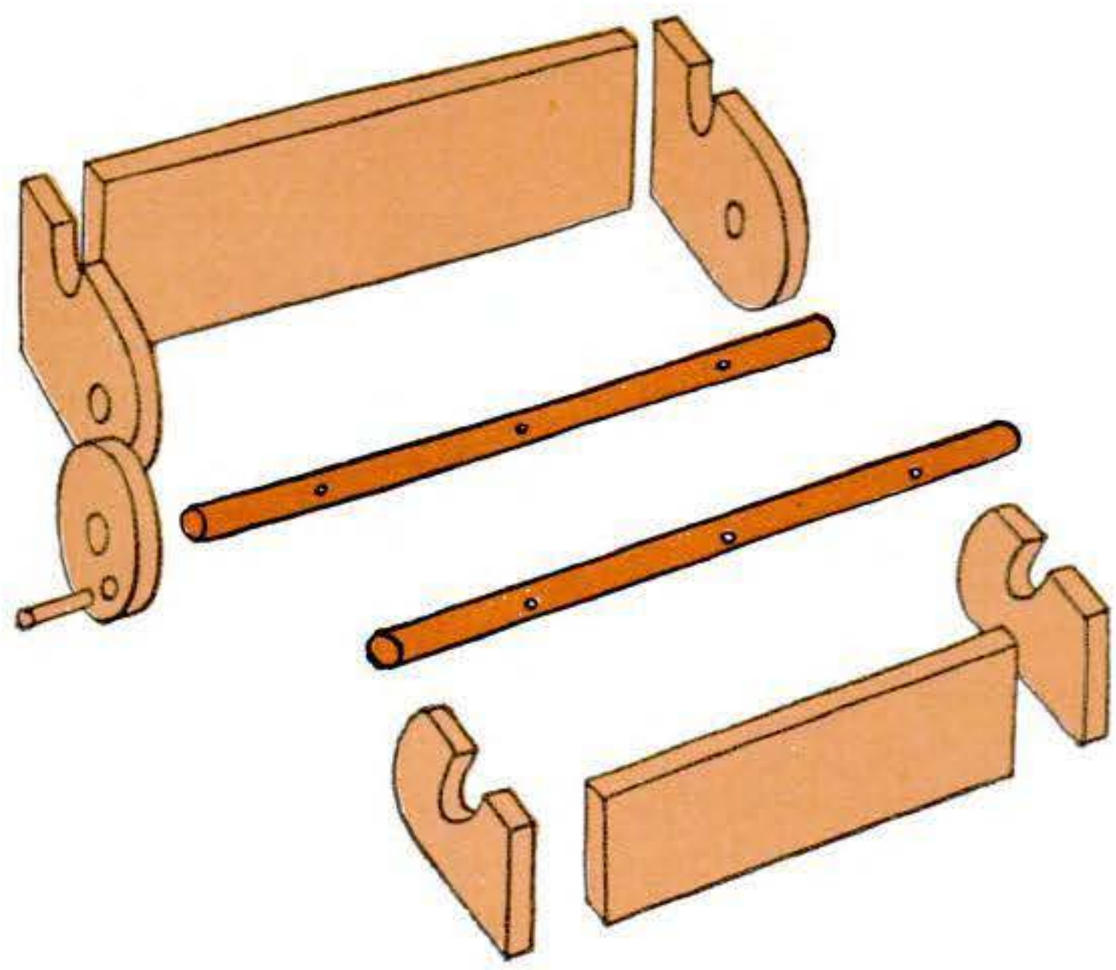
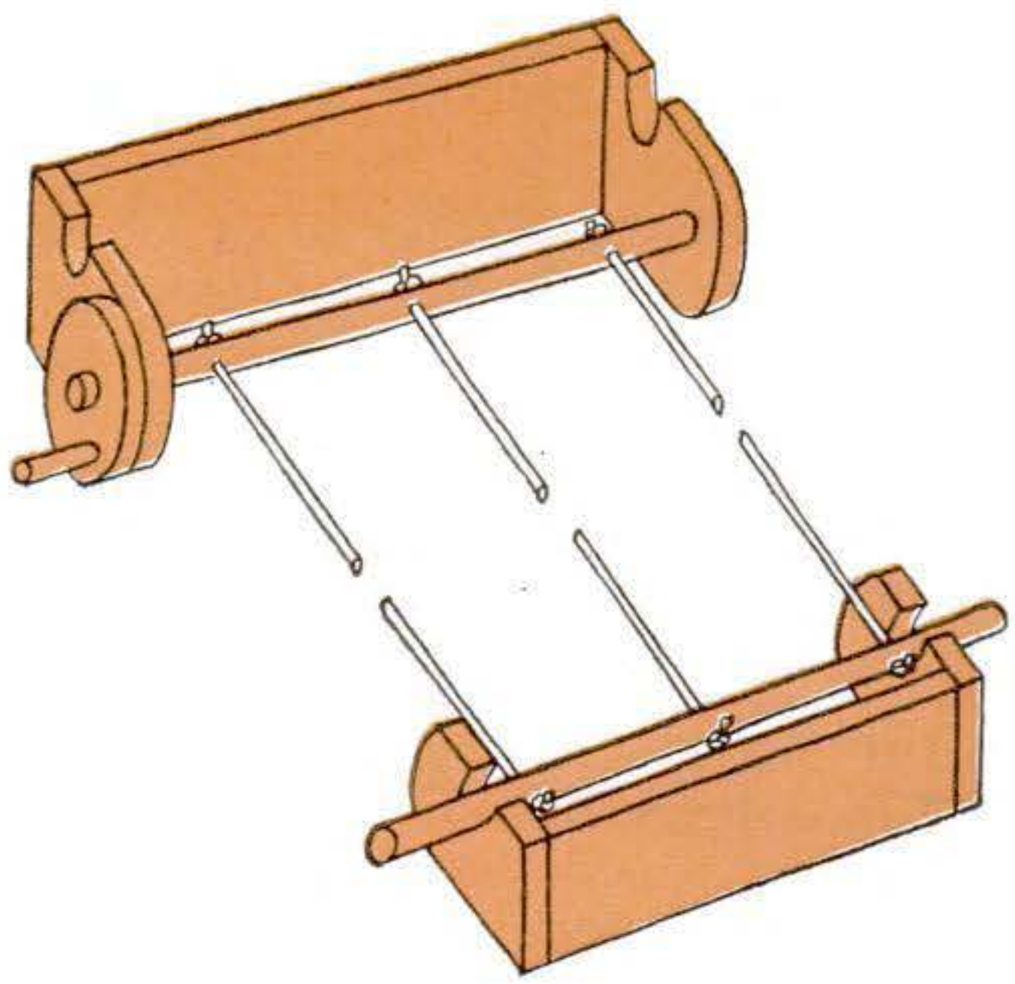
Wordless Workshop

By Roy Doty and Larry Crain







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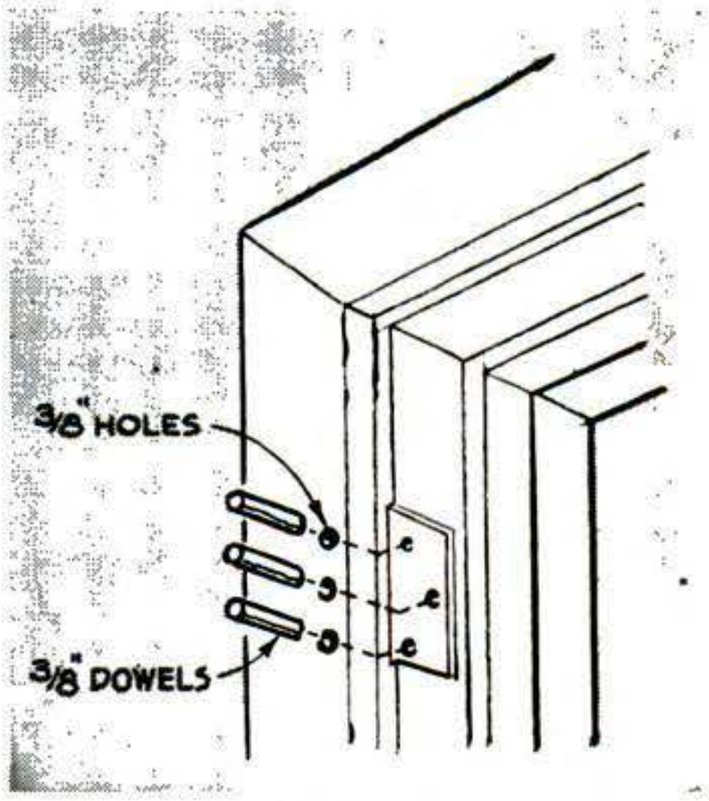
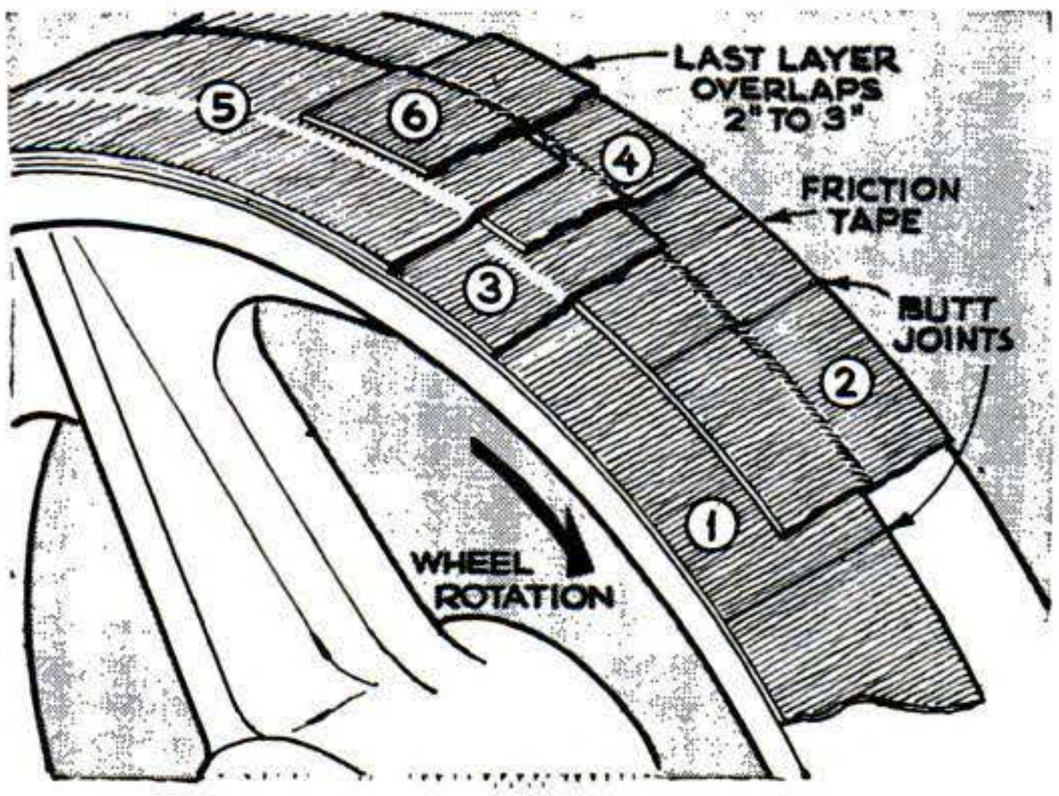
Flood lamp checks flash effects before you shoot

Here's a simple, easy way to check lighting with a small movie reflector flood lamp. Fastened to the head of your electronic flash gun, it allows you to see the lighting effects before shooting a picture. I turn on the photoflood, move it about until I get the exact lighting desired, then snap it off and take the picture with the electronic flash gun in the usual manner.—*Ken Patterson, Regina, Sask.*



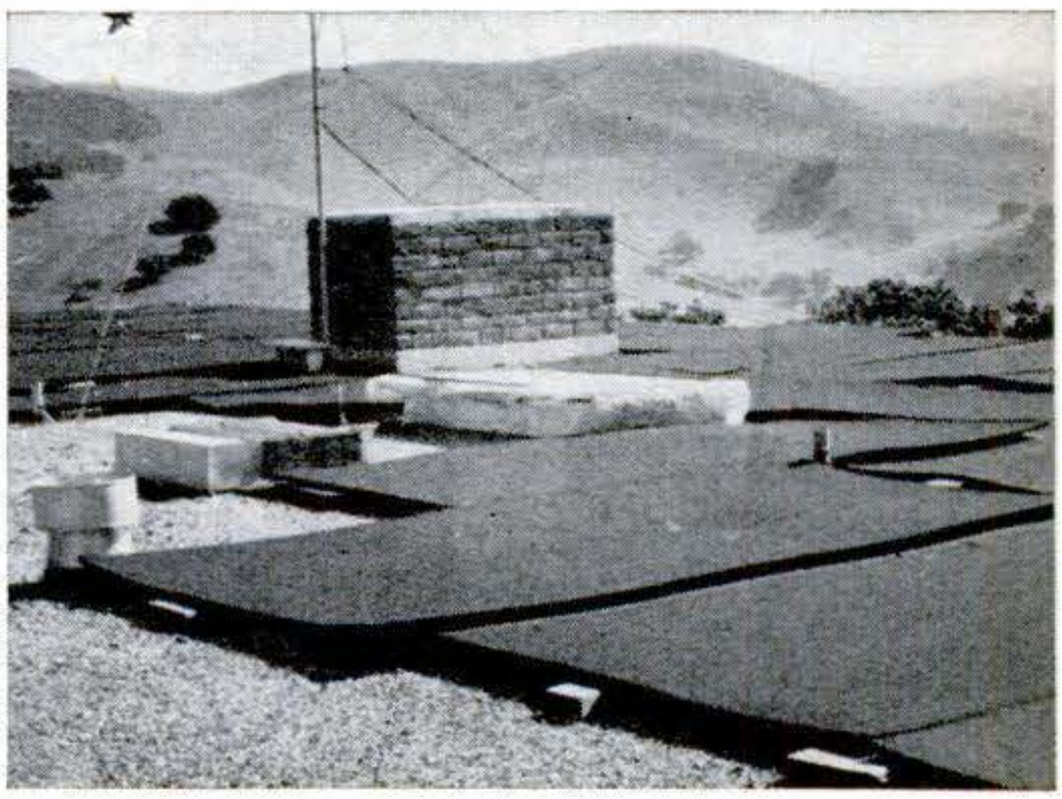
Hinges hold fast in worn casings

When hanging new doors in old casings, you can be stymied by holes worn too large for the hinge screws. Solve this by boring 3/8" holes in the casing at right angles to the old holes and rap 3/8" wood dowels into them. Then go back and drill starter holes to take the new hinge screws.—*John Marshall, Newburyport, Mass.*



Long-lasting bandsaw tire

I haven't changed my 12" bandsaw tire in 20 years, and it's still going strong. Friction tape did the trick. I wrapped the bare wheel with six layers in a counterclockwise direction, overlapping them at center of the rim as shown. The ends of the last layer overlap about 3"; the others butt. —*Bill W. Morant, Sierra Madre, Calif.*



Panels on roof cool house

Despite insulation in our flat built-up roof, room temperature on hot days pretty well matched that outdoors. But it dropped 10 degrees inside after I placed 2" scrap lumber on the roof every two feet to support large insulating panels. When the winter sun is welcome, the panels are stacked.—*H. Swigart, Carmel Valley, Calif.*

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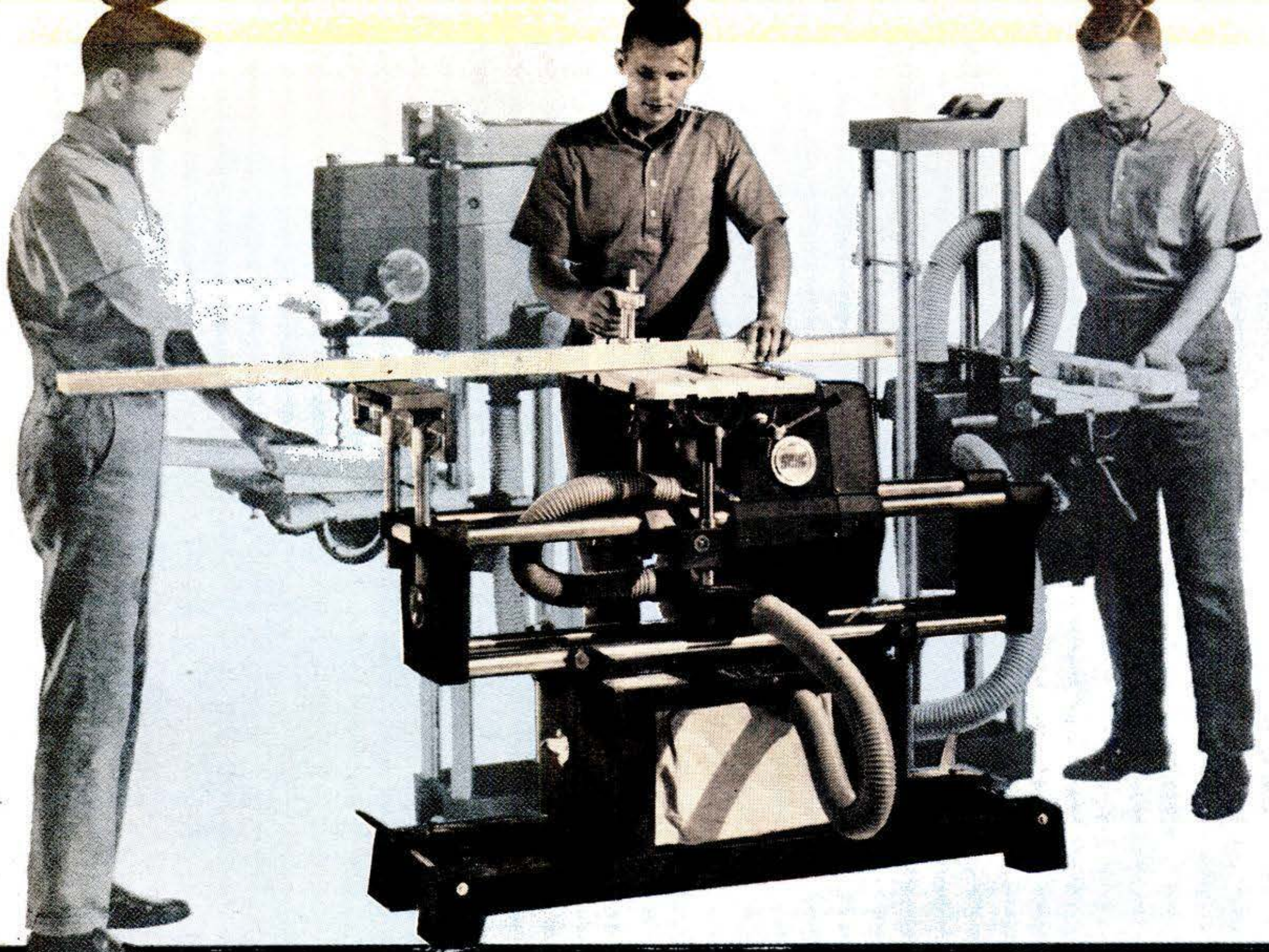

It's a drill press... *flip*... it's a table saw... *flip*... it's a shaper

Personal-use report:

New Seesaw Shopsmith Speeds Tool Changing

After 15 years, a famous machine gets an ingenious new design that makes it handier than ever

By Jackson Hand

FIFTEEN years ago, home-shop craftsmen got their first look at a strange new kind of "multipurpose" power tool—an odd-looking contraption called a Shopsmith. It tipped and tilted and swung and slid to become a table saw, a lathe, a disk sander, a drill press, and several other

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Shopsmith's latest—now it's a shaper, too

tools all rolled into one. It became a success overnight and was soon to play an important part in the rapid growth of home shops.

This month, a decade and a half later, Magna American will announce a brand-new version of its now-famous Shopsmith, a radically different model called the Mark VII. While still basically a Shopsmith, the Mark VII represents a fresh concept in multipurpose tools. It's designed to do two things: 1) to cram an even greater array of power-tool functions into an already versatile machine; 2) to make it faster and easier to switch from one tool to another than earlier models would permit.

The original Shopsmith had to be tilted from one end to swing the heavy motor carriage from its horizontal lathe or saw position up to its vertical drill-press position. The switch took a certain amount of huffing and puffing—a criticism that Shopsmith has had to live with for years.

In the new Mark VII, the entire motor carriage and bed ways tilt from an ingenious central pivot—like a seesaw. Just slide the motor to either side of the seesaw and it becomes a counterweight, making it easy to tilt the bed to a vertical position in either direction. Instead of *you* lifting the motor up, the motor's weight does the lifting for you, pushing the bed downward as you raise the light end upward.

Easy does it. A simple latch arrangement lets you lock the ways quickly in any of three positions—vertical to the left, vertical to the right, or horizontal. In its horizontal position, the Mark VII provides the customary Shopsmith functions of lathe, table saw, disk sander, and horizontal drill. Tilted up one way, it becomes a drill

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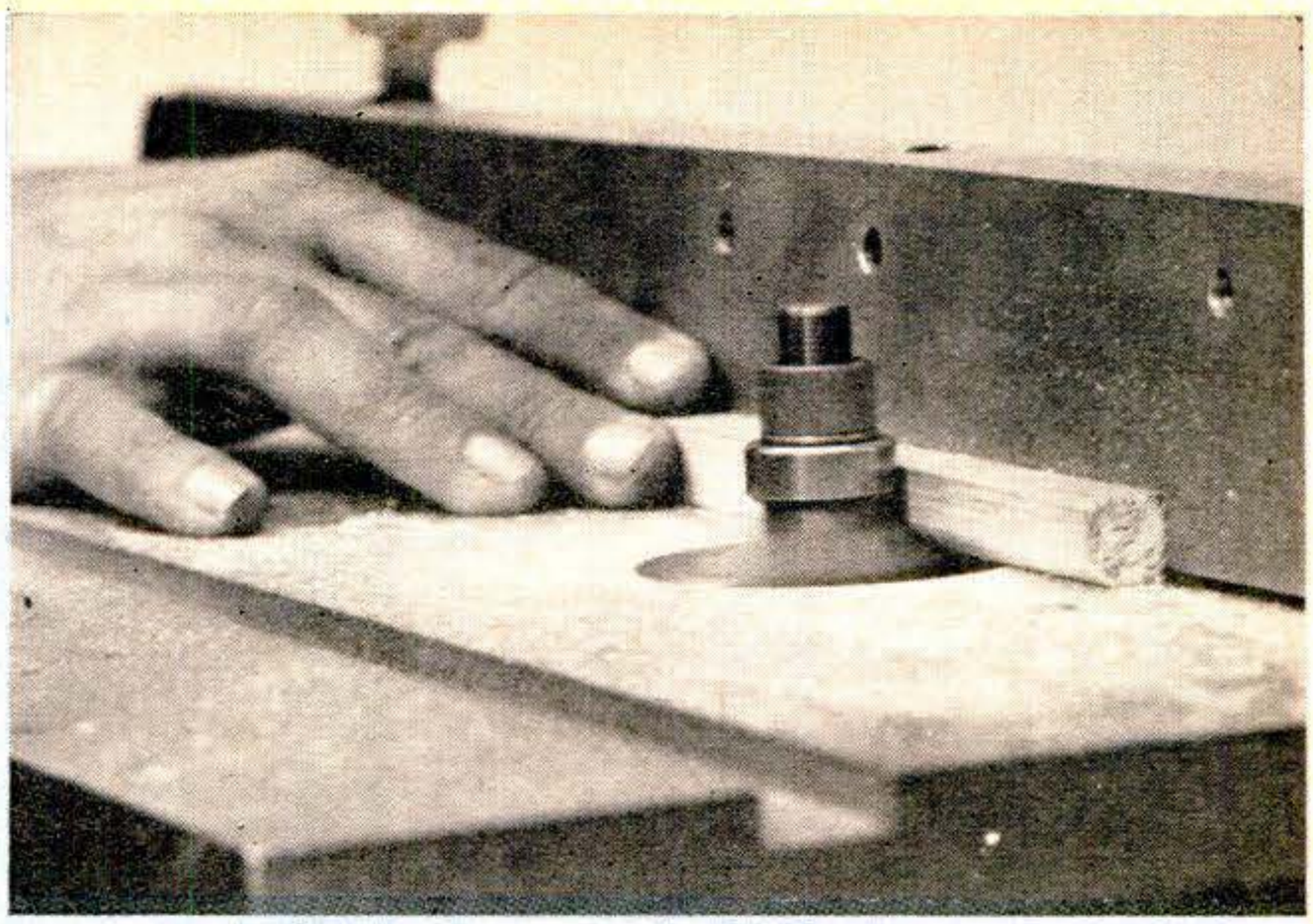
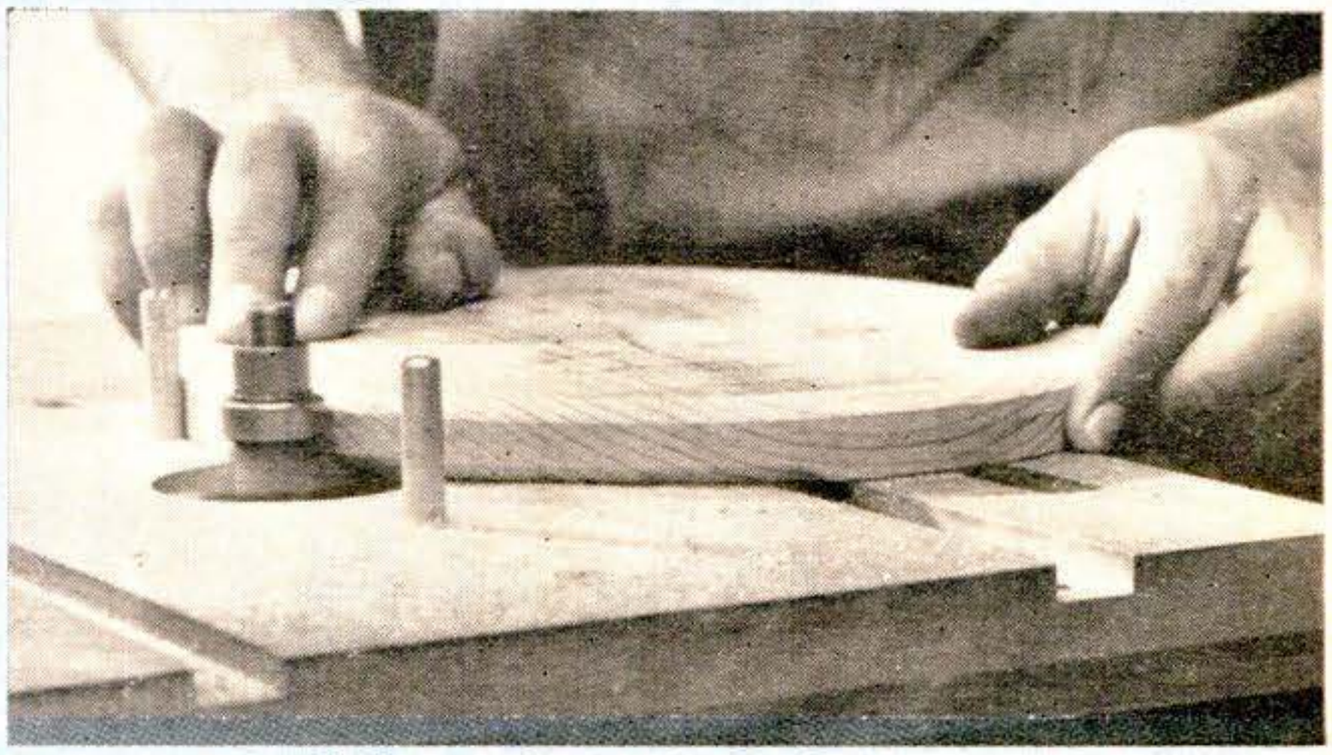
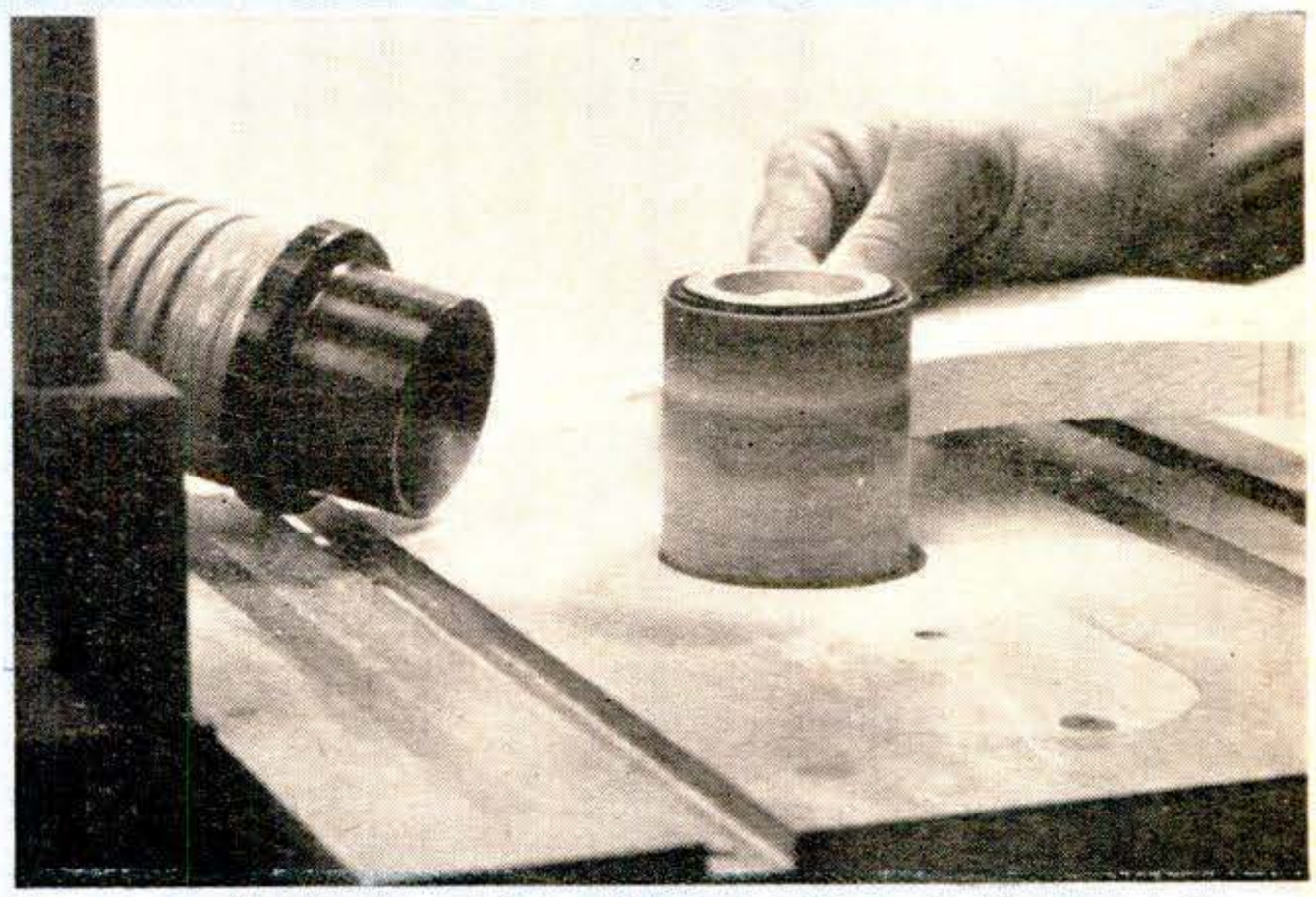


Tilted upside down, the drill press turns into a shaper, adding another tool to Shopsmith's versatility. Here, molding is shaped between the cutter and regular rip fence. A split-type shaper fence is also available.



Shaping irregular stock like this disk is done against guide pins and a collar on the cutter, with the fence removed. Pins screw into holes that can also be used to bolt on a regular shaper fence or a homemade one.



In same shaper position, the upright spindle can also be fitted with accessories like this sanding drum. The dust-collector hose can be unplugged from the machine's housing and used this way to pick up sanding dust.

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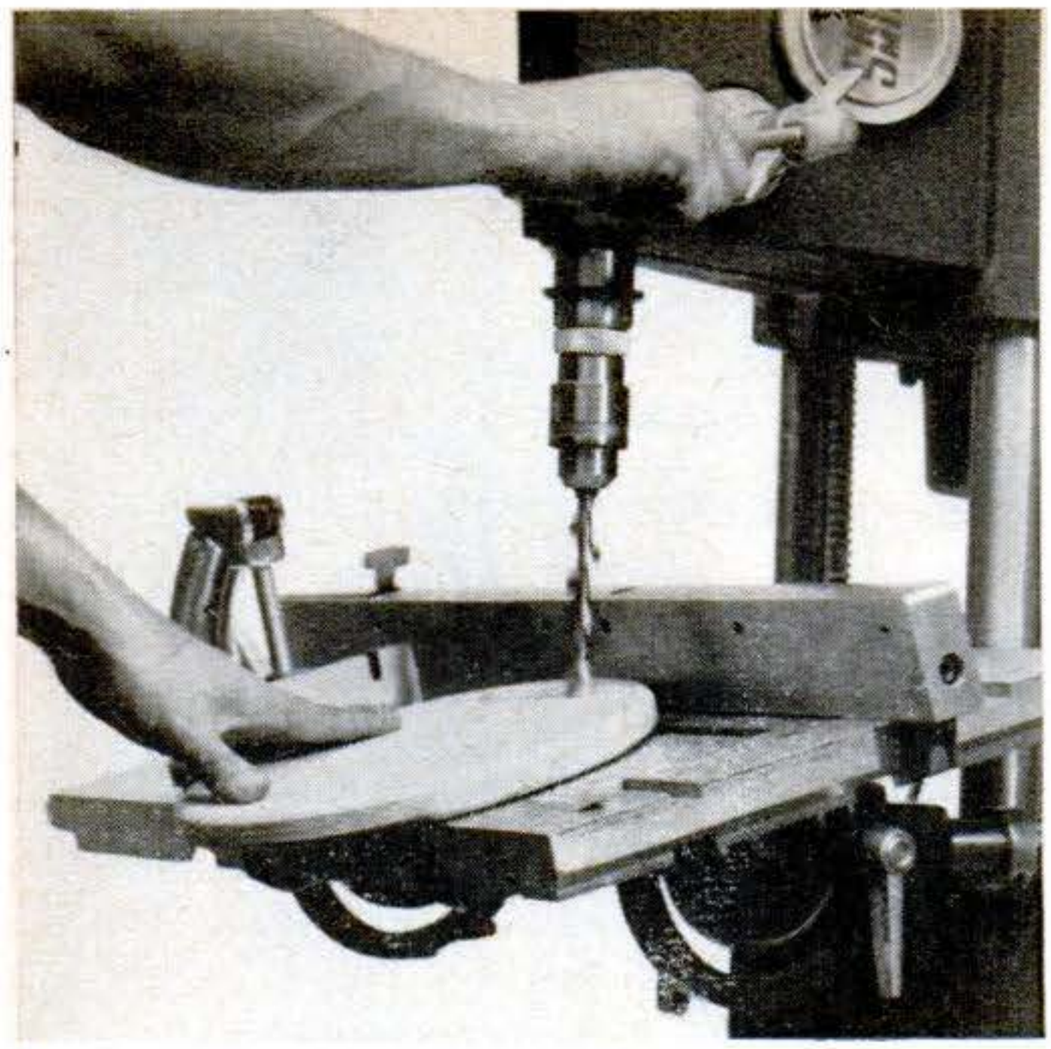

As a drill press, Shopsmith does some extra tricks. Tilting table lets you drill at an angle. Fence and miter gauge, normally used for sawing, help position drilled work, too.

press—again like the conventional Shopsmith.

But here's a new twist: Tilt the bed up in the opposite direction and you put the motor below the drill-press table instead of above it. In this position, the spindle points upward, the table flops over, and Shopsmith has pulled a brand-new trick out of its hat—it's become a shaper.

With any of dozens of standard shaper cutters mounted on the spindle, you can do a variety of molding jobs from tongue-and-grooving lumber to putting a rabbeted lip on cabinet doors. In the same shaper position, the upright spindle can also be fitted with other accessories, such as sanding drums and rotary files.

Testing the Shopsmith. The Mark VII is so new that I had to visit the Shopsmith plant in Cincinnati to put a handmade prototype through its paces. Most of what I found I liked. Here's how the new model stacks up:

- It's compact. Poised on a central pedestal, it no longer takes up floor space for those old ungainly legs that splayed out at the ends. The Shopsmith now looks and handles like a single-purpose shop tool with all the advantages of multitool versatility.
- The two-way tilt is a slick improvement. Besides adding the shaper function, it also goes a long way toward eliminating the time and fuss it takes to switch tool setups—the basic shortcoming of any multipurpose machine. It takes only seconds to flip the tool to any position, and you can do it with one finger.
- The motor carriage is now crank-driven along the ways through a rack-and-pinion arrangement. This makes it easy to move the power head up and down the ways when the machine is in a vertical position—a job

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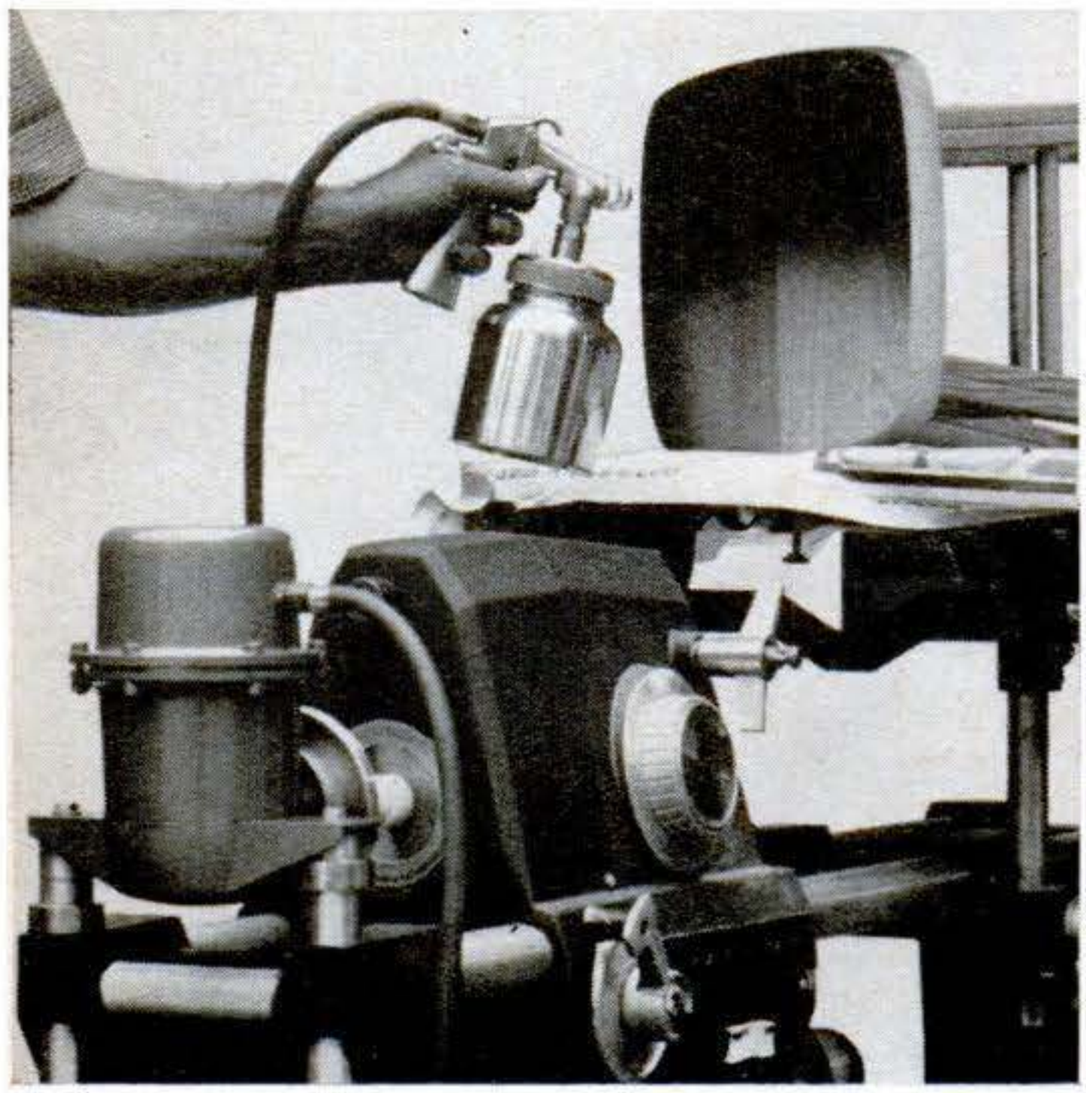
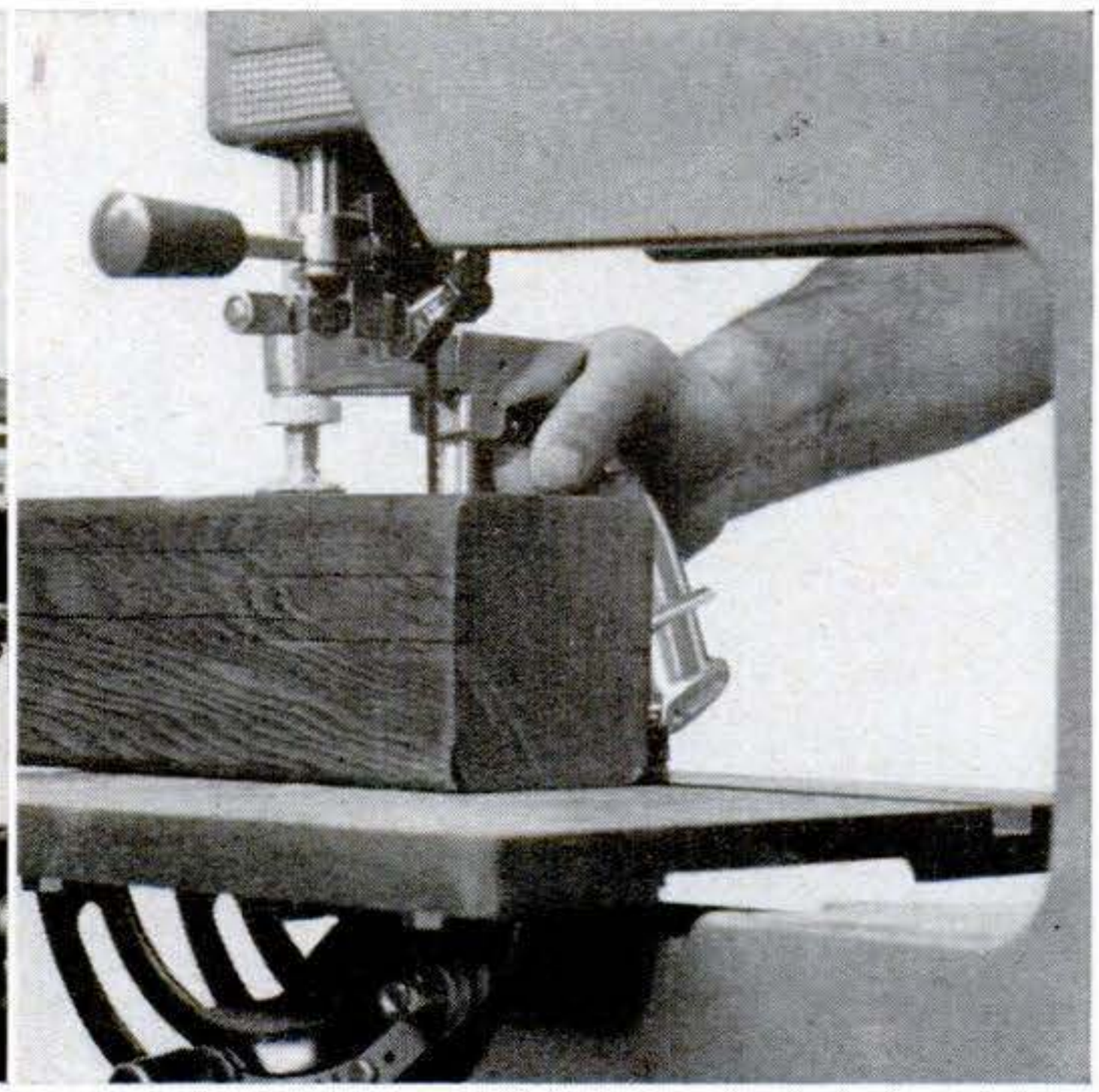
Add-on tools fit the new Shopsmith as well as the old



Paint-spray compressor, driven from the Shopsmith's motor, is one of five extra tools you can add to the basic machine. Compressor generates enough pressure to inflate an auto tire.



Accessory bandsaw has unusually big capacity for an attachment, can chomp through thick stock like this four-by-four. Other add-on tools are a jigsaw, jointer, and belt sander.

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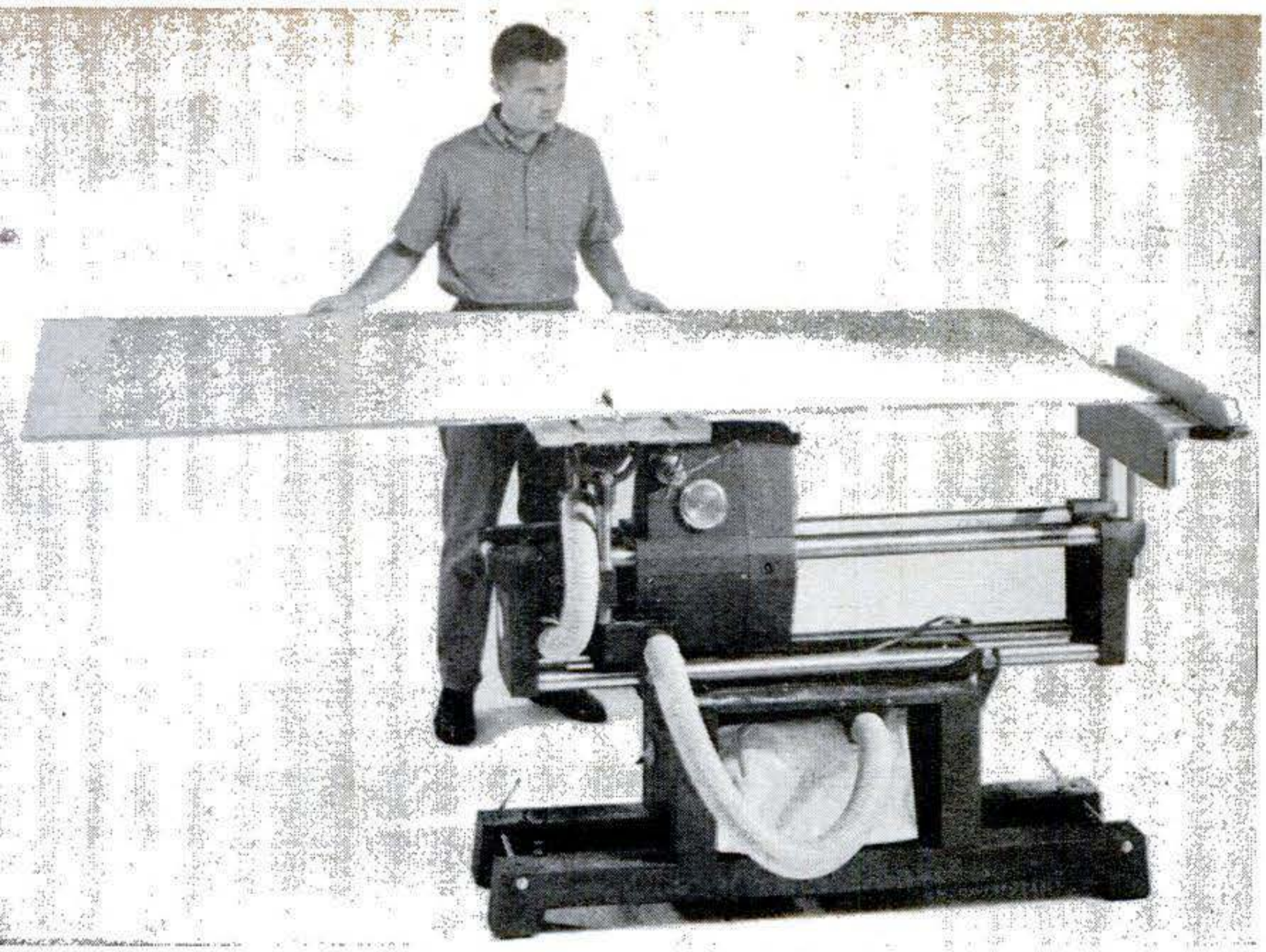
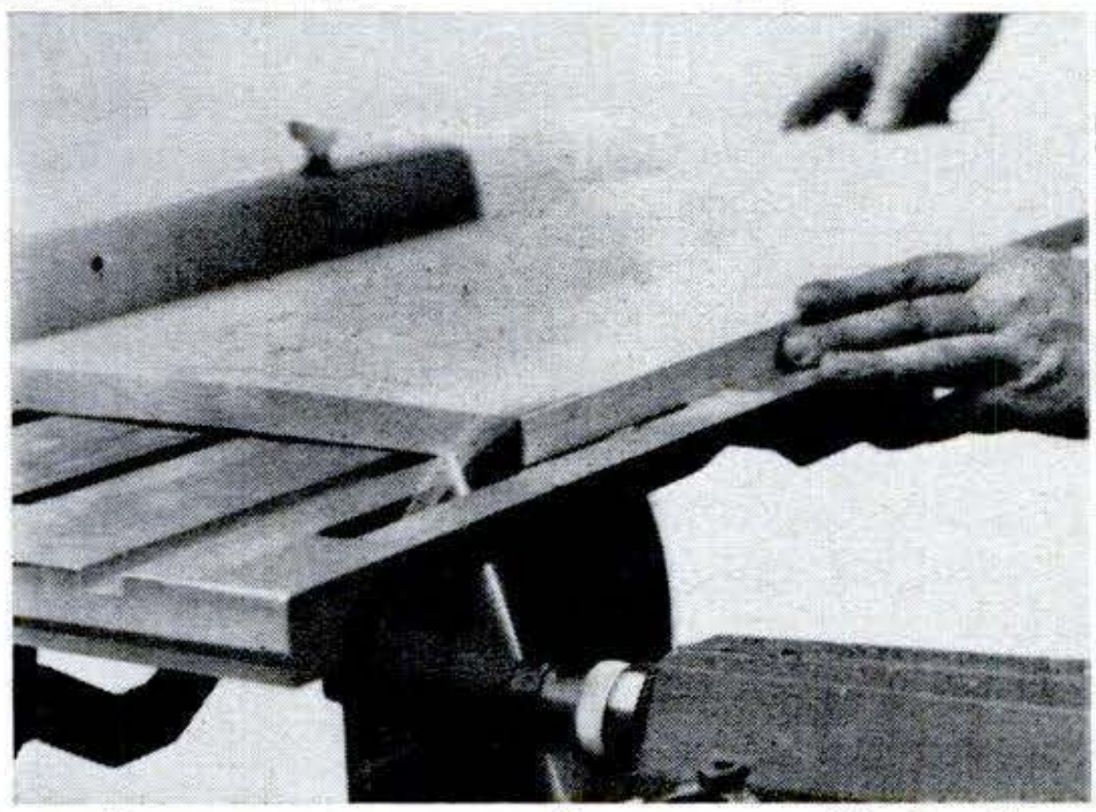
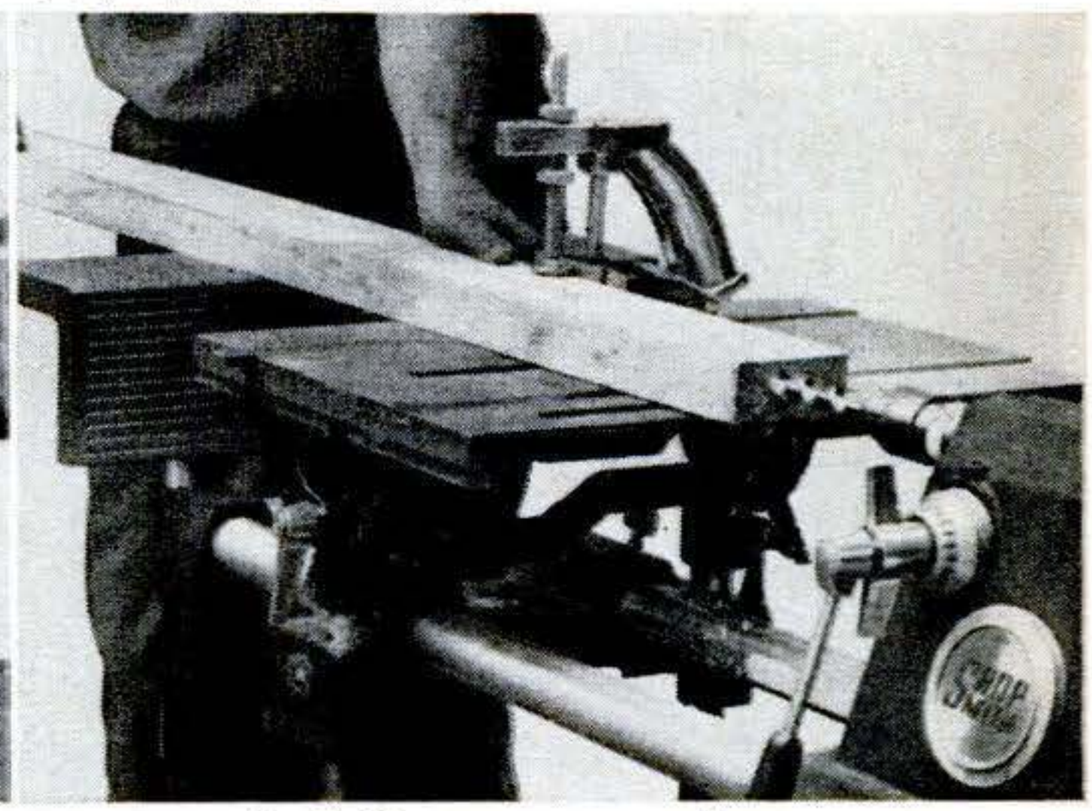


There's the best of the old, plus a lot that's new

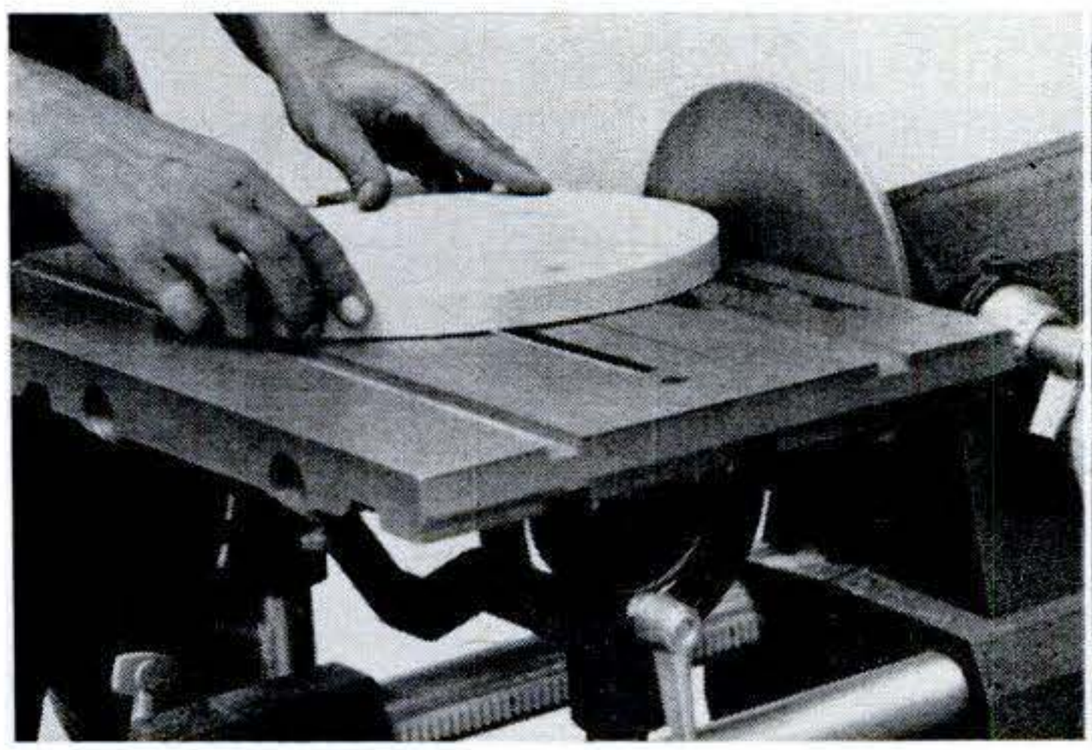
Long reach of the new Mark VII lets you saw clear to the middle of a 4′-by-8′ sheet. Note how the rip fence can be mounted on the outboard support to give you, in effect, a whopping 4′-wide saw table. The built-in vacuum system draws sawdust automatically into a bag at the bottom.



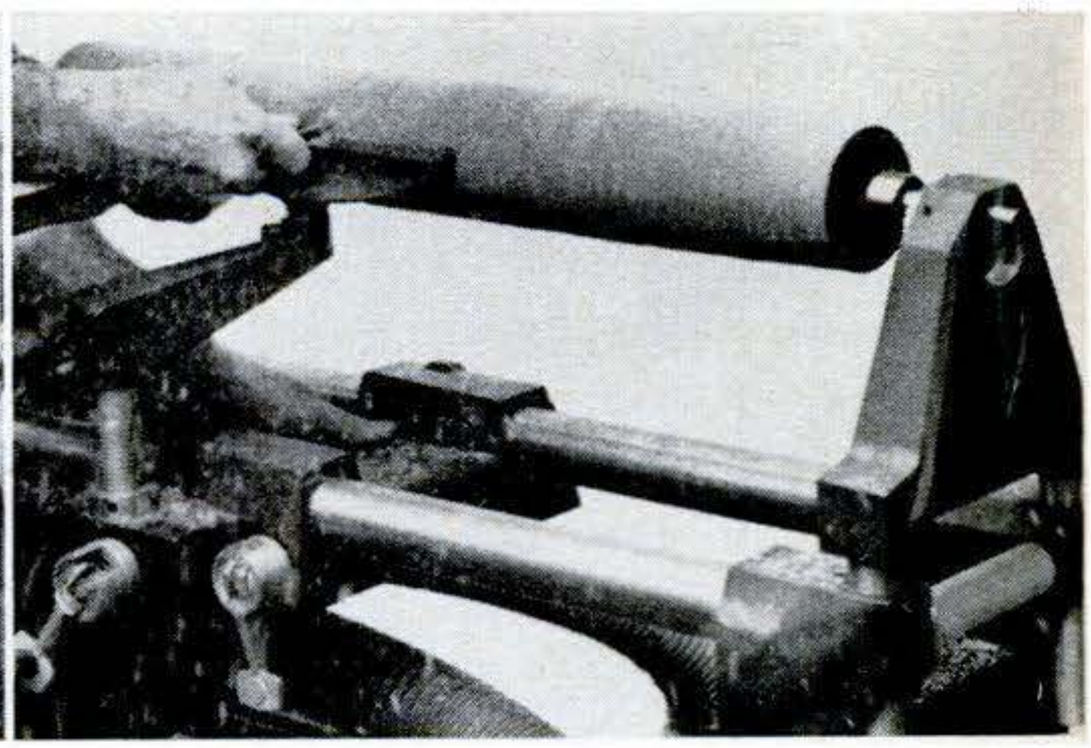
Here's a nice, new touch—an extra blade slot in the saw table way over near one edge. This lets you rip wide boards between the fence and the blade. There's also the usual center slot.



Horizontal drill press, a welcome carry-over from earlier models, lets you bore long stock easily. Stock can be fed by hand, or drill bit can be advanced with the motor's quill feed.



New double-faced disk sander is flat on one side for rough cuts and conical on the other for fine finishing. Conical side eliminates swirl marks, is used with slight table tilt.



As a wood lathe, Shopsmith is rated one of the best because of large capacity and an unusual feature: You can make accurate cuts by simply sliding the toolrest along the ways.

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Catch a Falling Star?

Sure, you can. And capture the moon and planets, too, on film—with simple photographic equipment

By Bob Hering

IN TODAY's age of space, there's more excitement than ever in photographing the heavens. Anyone can tackle astrophotography with modest, relatively inexpensive equipment.

While any camera with a precise means of focusing is satisfactory for taking pictures of the heavens, you'll find a 35mm single-lens reflex about the most practical. Using an SLR, you can focus directly on the ground glass. For maximum use, the camera should accept interchangeable lenses.

You can shoot many interesting pictures without investing in a telescope—star trails, meteor showers, and auroras (northern lights). But to increase image size and detail, you'll need a telescope. Most sky objects are dim. What's needed is more light power, not magnifying power. The bigger the telescope, the more light it will gather.

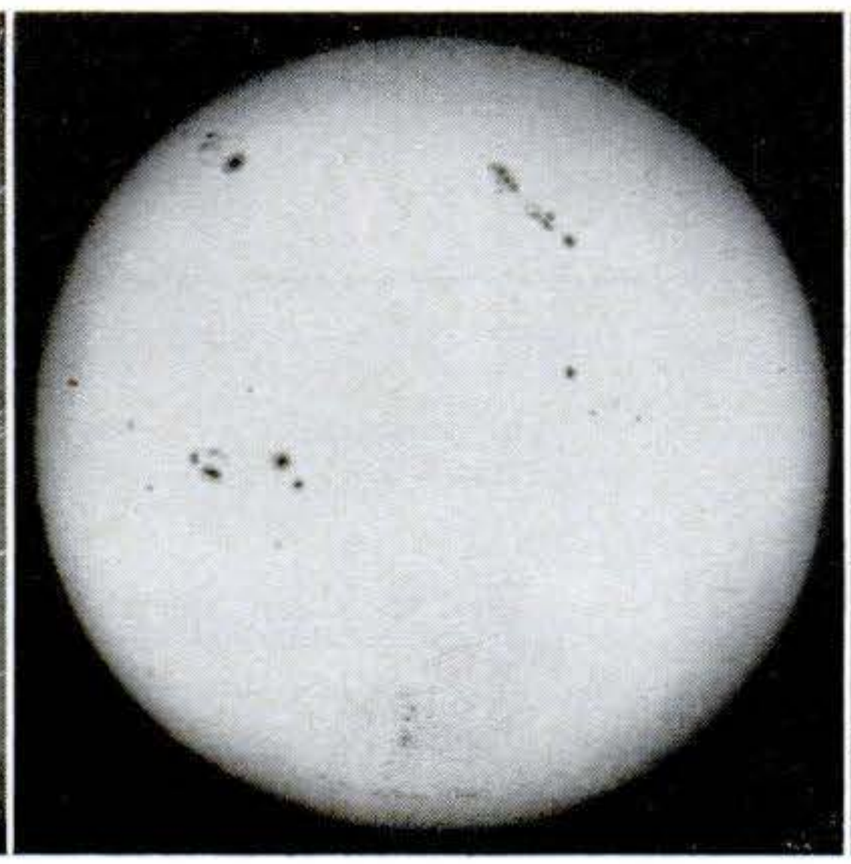
It's best, for fun photography, to choose about a 6″ reflector telescope, although 3″ and 4″ scopes can be used for lunar and solar photography. You can buy scopes from such companies as Edmund Scientific Co., Barrington, N.J., and Criterion Manufacturing Co., Hartford, Conn. A 6-inch scope will cost about $200. You'll need an adapter for mounting the camera to the telescope and, for tracking objects during long exposures, an equatorial mount, either manual or power-driven.

There are three practical camera-telescope optical arrangements: prime focus, eyepiece projection, and eyepiece-camera projection (see illustration on page 121).

Any time of the year is satisfactory for astrophotography. But a clear, dark, moonless night, or when the moon is in a crescent phase, are best. Moonlight or lights

Star trails and a faint auroral display were recorded in this 20-minute exposure at f/3.5, with Tri-X film and a Minolta Autocord camera.

Sunspots in this solar picture were shot at 1/100, using a 3″ refractor telescope. The excess amount of light complicates solar photography.



The Pleiades is a spectacular star cluster to photograph. Exposure below took 30 minutes through a 4″ lens with a 20″ optical system.

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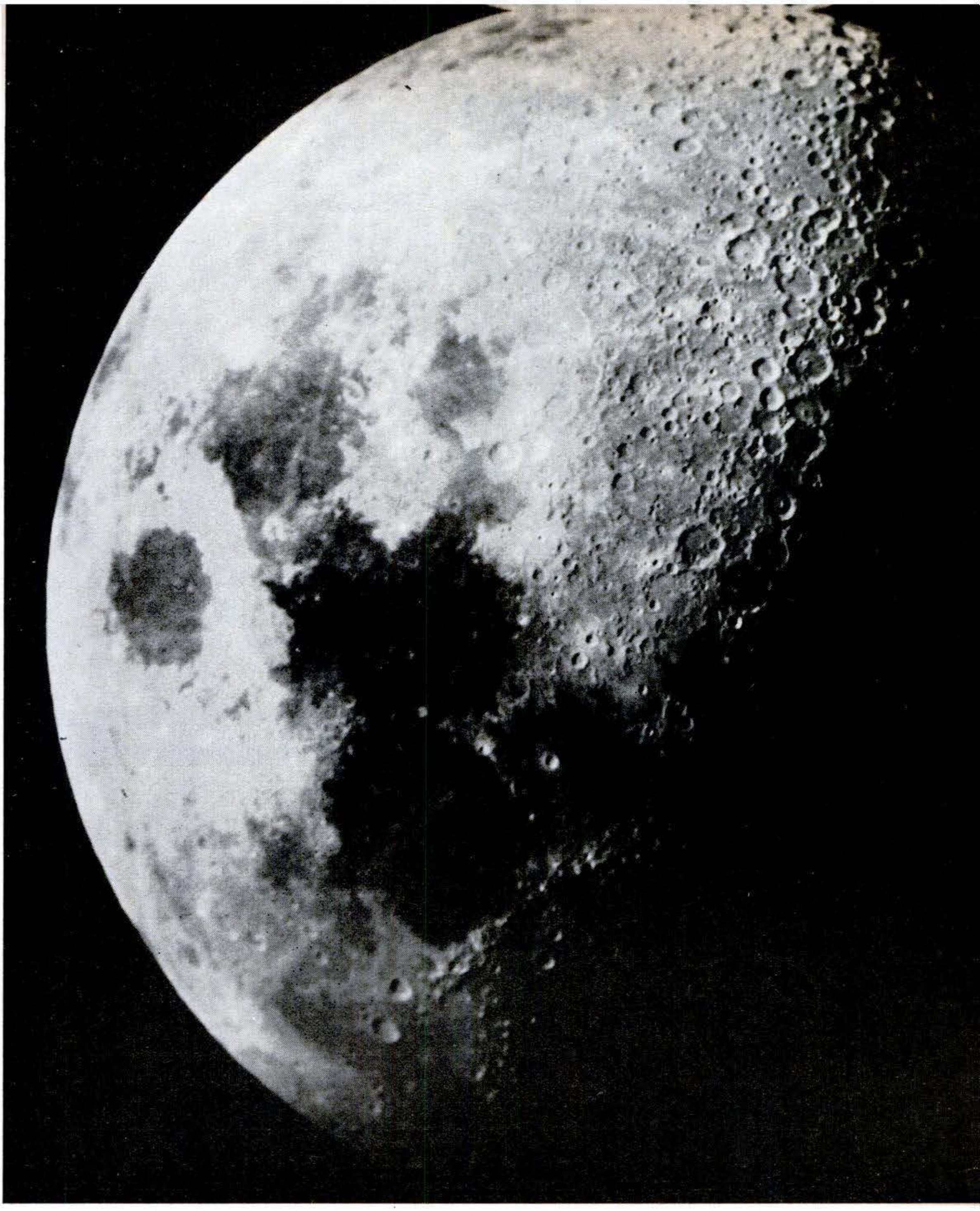

PHOTOGRAPHS BY MEMBERS OF THE AMATEUR ASTRONOMERS ASSN., NYC

The moon is one of the most fascinating and easiest subjects for your camera. It's the brightest and largest sky object you will photograph. The exposures vary greatly with the phase. A full moon is several times brighter than a quarter moon. Even with a small scope, you can get a fair-size image. The photograph above was taken with a 6″ refractor telescope, using eyepiece projection and a Leica camera. The exposure was two seconds on Microfile film.

CONTINUED

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Practical astrophotography outfit consists of single-lens-reflex camera, 6″ reflector telescope with electric drive and equatorial mount (without camera, $195).

from a city can fog your long exposures.

Since it is difficult to calculate exposures accurately, because there are many variables, it's advisable to bracket.

Obviously records are invaluable. From the start be scientific; follow an exact method of data recording. Then you can refer back to it for future work.

The type of film you use will depend on the object you plan to shoot. Sometimes a contrasty film will be needed, such as Microfile. One of the faster films may be best when you want to shorten exposures.

Star trails. As a starter, try photographing star trails. Such pictures show clearly the earth's rotation. With your camera on a tripod and loaded with medium-speed roll film, such as Plus-X, aim it toward the celestial pole. Using the lens wide open, make a series of exposures—10 minutes and longer. You add interest by including the silhouette of some familiar foreground object, such as trees or buildings.

The length of exposure is limited only by sky fog. Stars will record as arcs (star trails). You can also create interesting effects

GENERAL EXPOSURE RECOMMENDATIONS FOR AMATEUR ASTROPHOTOGRAPHY

SUBJECT	INSTRUMENT	MOUNT	OBJECTIVE	*f*-NUMBER	FILMS and PLATES	EXPOSURE (depending on conditions and brilliance)	OBJECTS
STAR TRAILS	ANY CAMERA	RIGID SUPPORT	ANY LENS	WIDE OPEN	FAST PANCHROMATIC	UP TO 30 MIN. OR MORE	ANY STAR
METEORS	ANY GOOD CAMERA	RIGID SUPPORT	GOOD LENS	f/6.3 OR BETTER	FAST PANCHROMATIC	10-30 MIN.	METEOR SHOWERS
AURORAS	CAMERA WITH FAST LENS	RIGID SUPPORT	FAST LENS	f/4.5 OR BETTER	FAST PANCHROMATIC	1/25 SEC. TO 30 MIN.	ALL TYPES OF AURORAS
MOON	CAMERA, OR CAMERA WITH TELESCOPE	FIXED OR EQUATORIAL WITH OR WITHOUT DRIVE	1″ DIAMETER OR LARGER	ABOUT f/12	SLOW PANCHROMATIC	1/100 SEC. TO 10 SEC.	ALL PHASES
STARS AND COMETS	CAMERA, OR CAMERA WITH TELESCOPE	EQUATORIAL WITH GUIDING SIGHTS	1″ DIAMETER OR LARGER	f/6.3 OR BETTER	FAST PANCHROMATIC	10 MIN. TO 1 HR.	ANY STAR, MILKY WAY, SAGITTARIUS (AND VICINITY)
CLUSTERS AND NEBULAS	CAMERA, OR CAMERA WITH TELESCOPE	EQUATORIAL WITH SIGHTS AND DRIVE	1″ DIAMETER OR LARGER	ABOUT f/6.3	FAST PANCHROMATIC	10 MIN. TO 1 HR.	PLEIADES, ORION, CYGNUS, ETC.
PLANETS	CAMERA, OR CAMERA WITH TELESCOPE	EQUATORIAL, PREFERABLY WITH DRIVE	1″ DIAMETER OR LARGER FOR DETAIL 6″ AND UP	USE WHAT YOU HAVE	FAST PANCHROMATIC	1/2 TO 15 SEC.	ALL PLANETS
SUN (NEVER LOOK AT THE SUN WITH ANY OPTICAL DEVICE!)	CAMERA, OR CAMERA WITH TELESCOPE	RIGID OR EQUATORIAL WITH OR WITHOUT DRIVE	NEUTRAL-DENSITY FILTERS 4.00-6.00 OVER 1″ OR LARGER MAIN OBJECTIVE	f/32-f/64	SLOW PANCHROMATIC	1/1000-1/25 SEC. WITH NEUTRAL-DENSITY FILTERS 4.00-6.00 OVER MAIN OPTICAL OBJECTIVE (NOT THE EYEPIECE!)	SUNSPOTS

Adapted from Eastman Kodak chart

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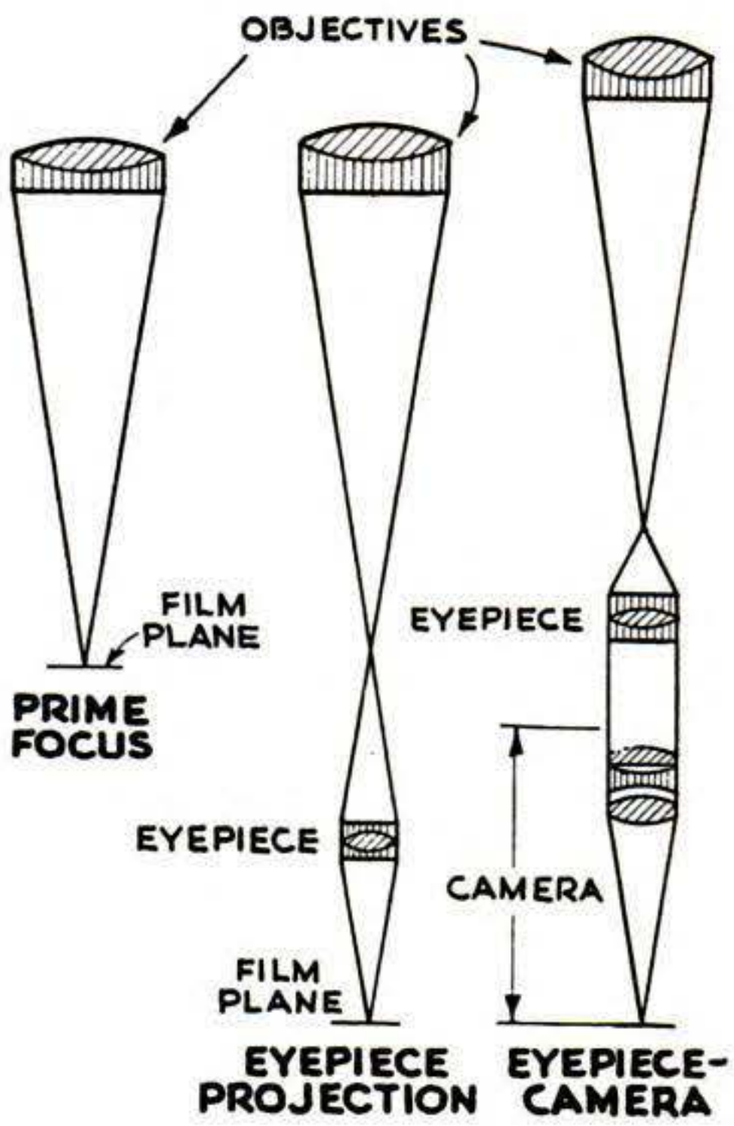
by interruping an exposure for several minutes, then completing it.

Meteors are shot with the same stationary setup as star trails, but it's rather difficult to know where to point your camera. Their appearances are erratic, requiring patience and luck. It's best to choose a time when known showers are expected. Using two or three cameras aimed at different sections of the sky will increase your chances of photographing meteors.

Auroras may be photographed with an ordinary unguided camera mounted on a tripod. Since the objects are faint and move along rapidly, one of the faster lenses should be used. It is also possible to photograph bright auroras on fast film at 1/25 of a second, but usually you will

[Continued on page 205]



Basic telescope-camera setups: Prime focus uses telescope objective only, for maximum sharpness. Eyepiece projection adds ocular to increase image. Eyepiece-camera couples camera lens directly to eyepiece. In each case, camera is attached rigidly to scope.

Throughout history comets have been among the top outer-space attractions. Their jetlike appearance and beauty make them outstanding photographic subjects. A fast lens and high-speed film are needed. The dramatic shot of the Arend-Roland comet above was exposed for 20 seconds on Royal-X film.

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How to build your own

Gas-Powered Snow-Trac

—with 25-m.p.h. scat

By E. F. Lindsley

YOU'RE in for a new kind of thrill if you've never plowed through powdery snow or flashed along shimmering ice at 25 to 30 m.p.h. Snow karting, a new wrinkle in winter sports, combines all the excitement of sledding or tobogganing with the added fun of breezing uphill as well as down under the galloping surge of a little gas-eating one-lunger.

Commercial snow crawlers range from $500 to over $1,000. You can build this one yourself for about $200 starting from scratch, or for as little as $150 if you already have an engine.

The Snow-Trac combines a rugged crawler-type drive for dig-in power with a pair of pivoted skis at the front to give fast, precise, automotive-type steering. The 7½-hp. engine used here gives hair-raising speeds up to 30 m.p.h., but is not a necessity. You can get plenty of action from more modest engines of four to six hp.

What about parts? Except for a few items, all parts shown here are standard fittings available from mail-order houses

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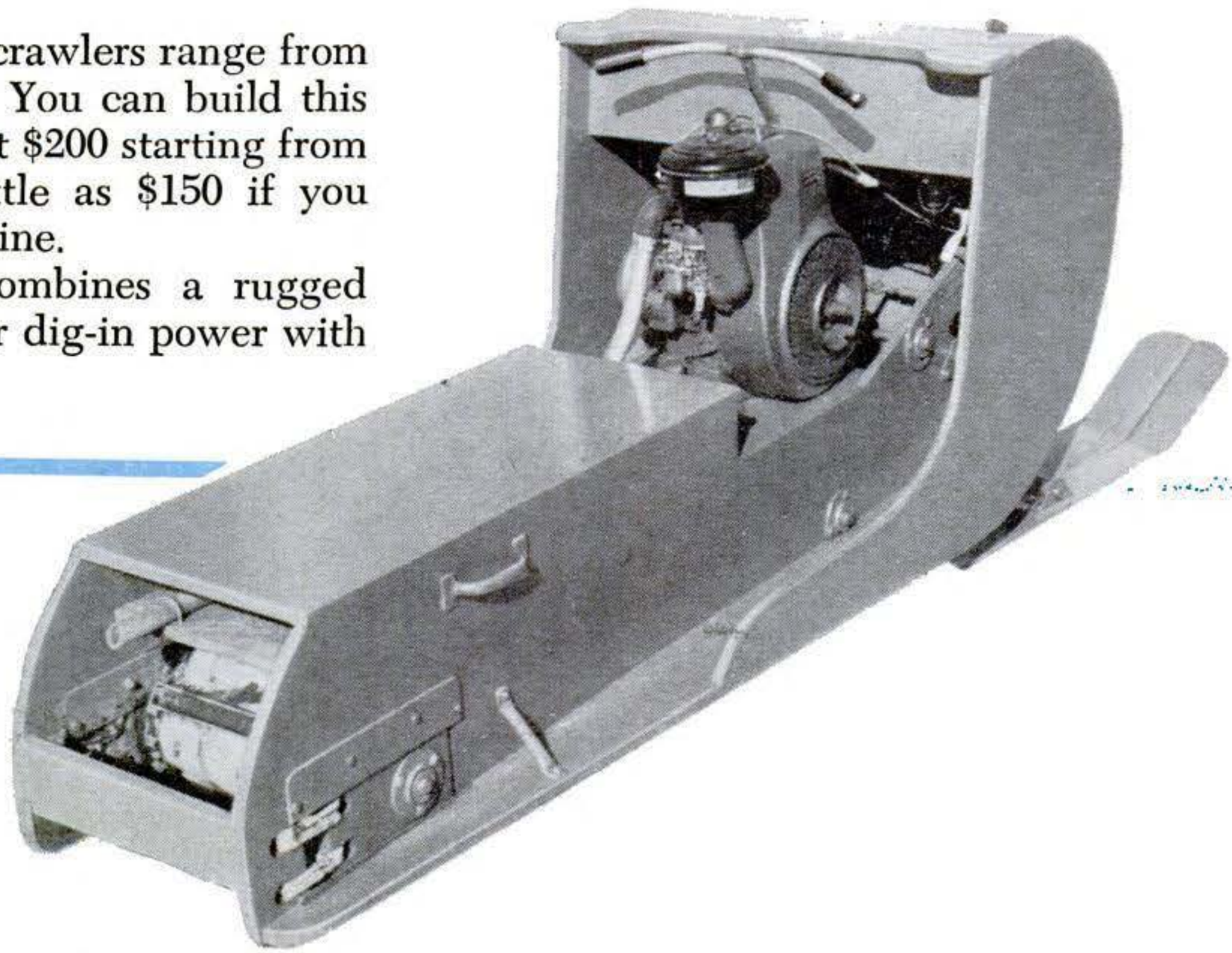

There's room for two aboard this rugged, compact power sled. Riders straddle center crawler track, giving the sled motorcycle-like stability. Engine mounts behind cowl.

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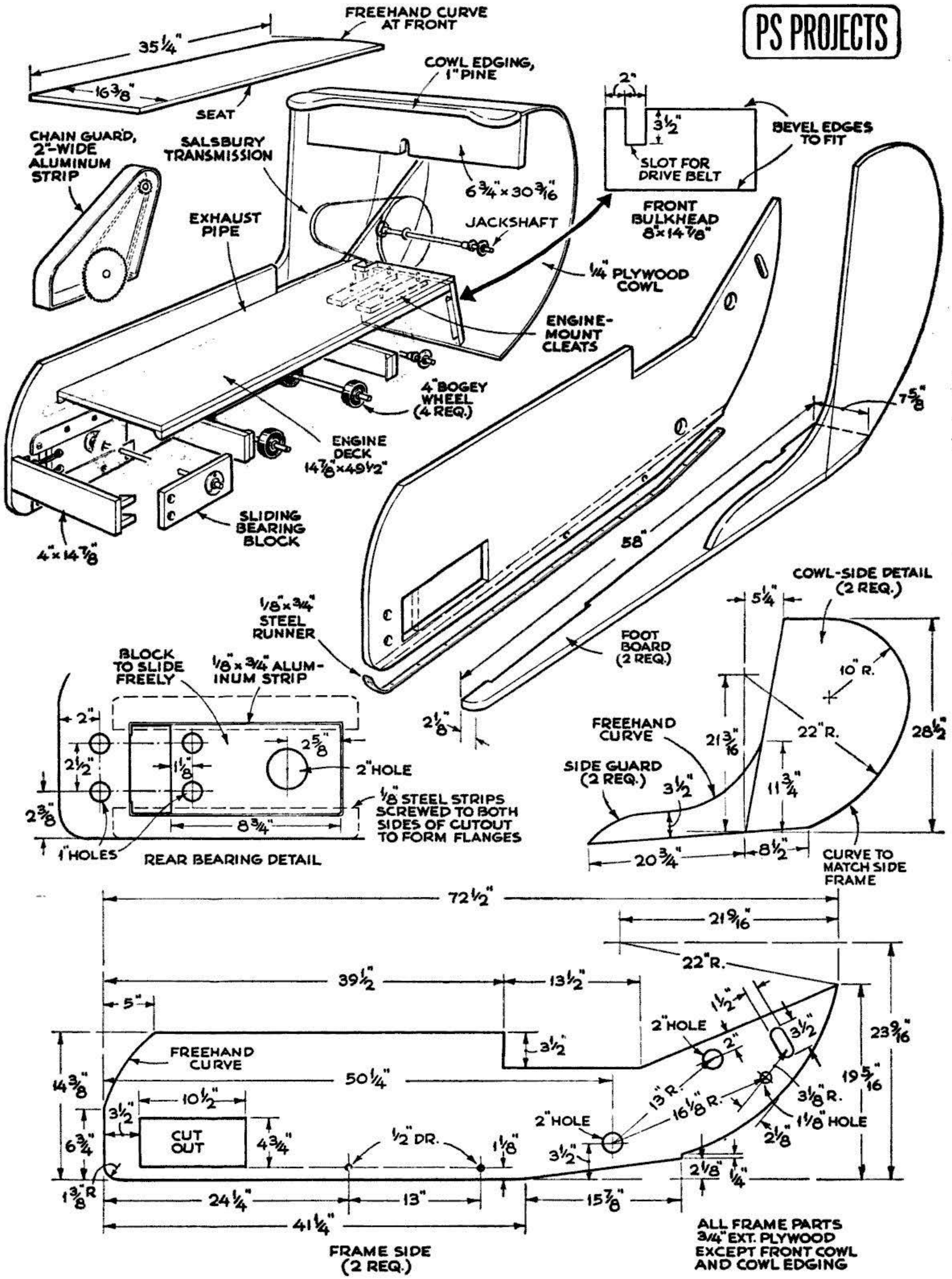

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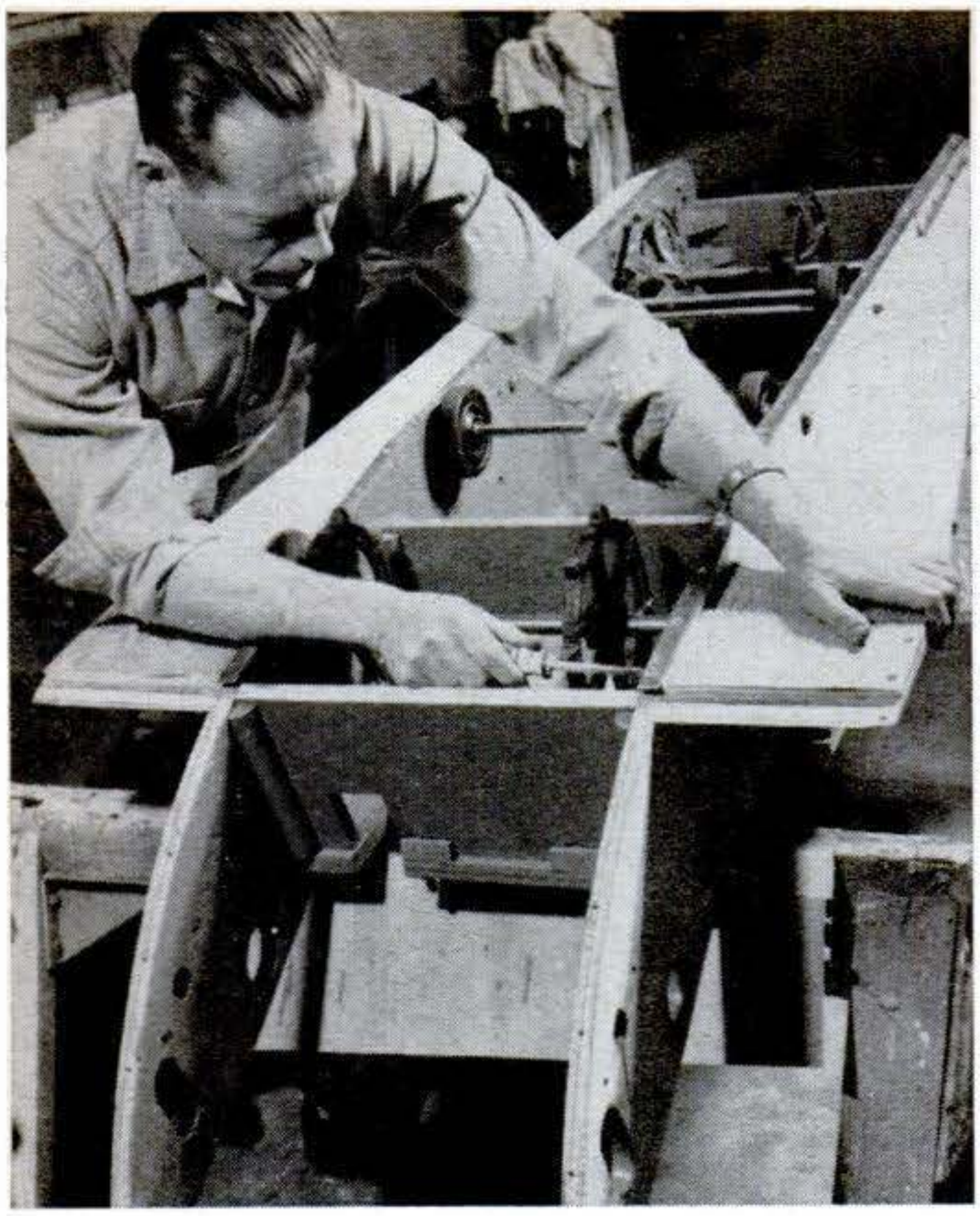


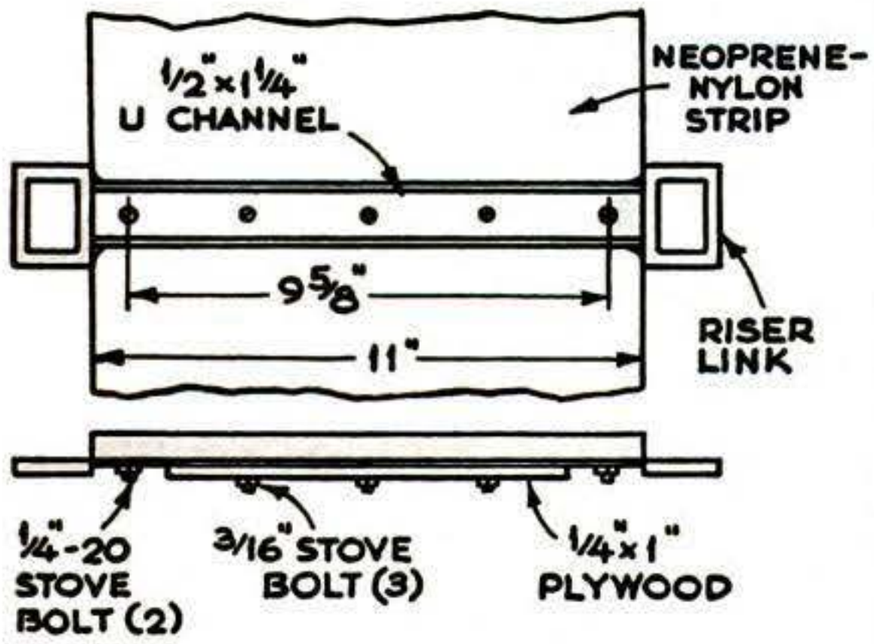
Automotive-type steering gives the Snow-Trac good control on turns. A crank arm on the central steering shaft is linked by tie rods to similar crank arms on the ski struts so that all parts move together. Note at left how the footrest boards are screwed to the side frames from the inside and are notched at the front ends to receive the curved-plywood cowl piece.

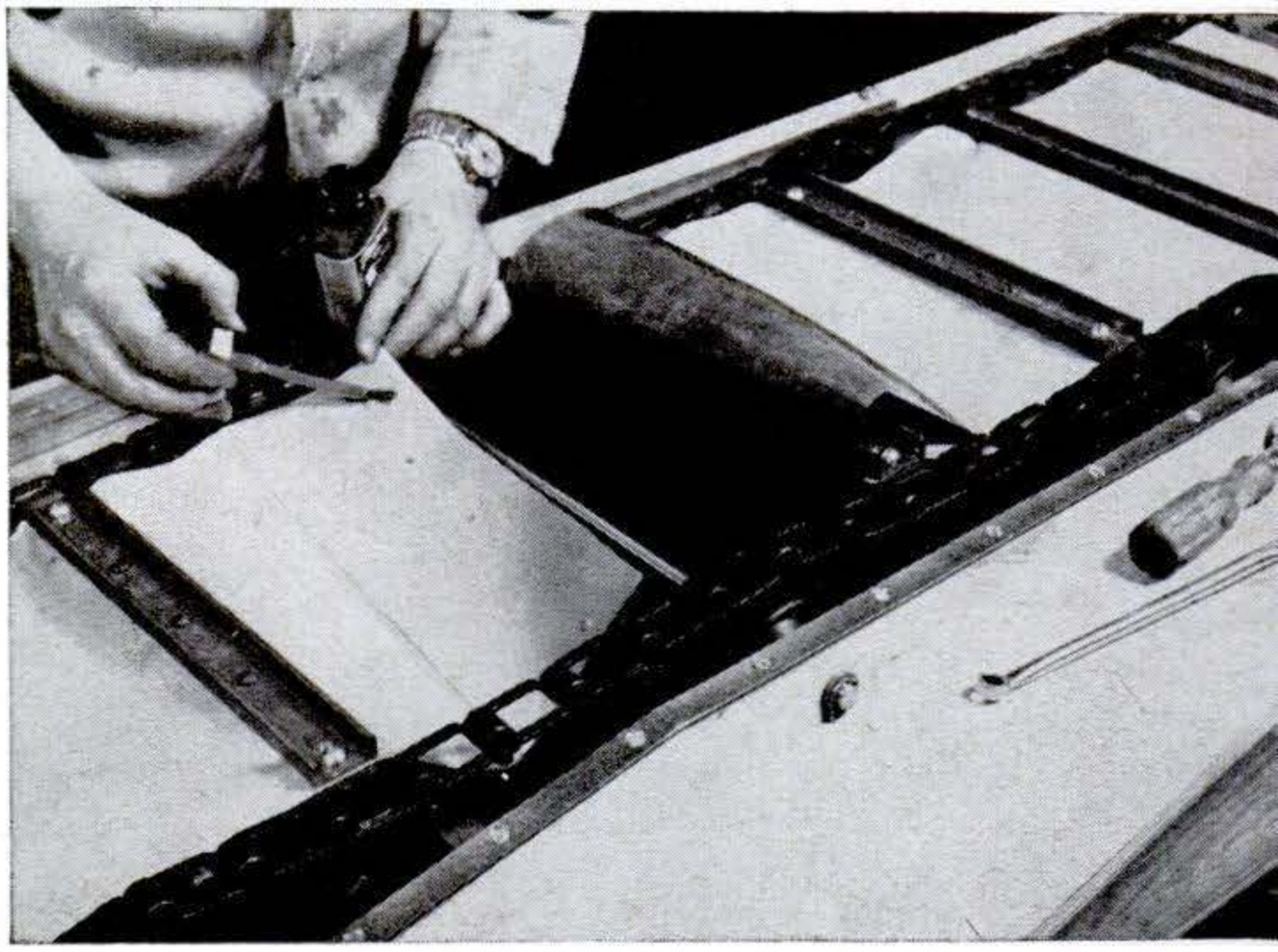
and kart-supply centers. The only parts you may have to hunt a bit for are the four large sprockets that carry the crawler track. These are sold by farm-equipment dealers. We chose a 9″ size, but their exact diameter isn't critical. Just be sure you get four of the same type and size. Suggested sources for these and other less-common parts are listed at the end of this article.

Most of the sprockets you'll find are designed to take standard No. 55 conveyor chain, sold by mail-order houses like Sears, Roebuck. You'll need 18′ of this. You'll also have to make one small alteration on the chain to adapt it to the crawler track.

To attach the crawler's traction-giving crossbars to the chain, you'll need to add "risers." These are bracketlike fittings that hook into the chain in place of the regular connecting links. They come in both left- and right-hand types and sell for about nine cents a link. Get enough of both rights and lefts to space

[Continued on page 184]





Crawler track consists of a continuous strip of neoprene-impregnated nylon belting running between U-channel crossbars. The belting is clamped to the crossbars with bolts and back-up strips of ¼″ plywood, as shown above. For added strength, coat the joints with waterproof cement.

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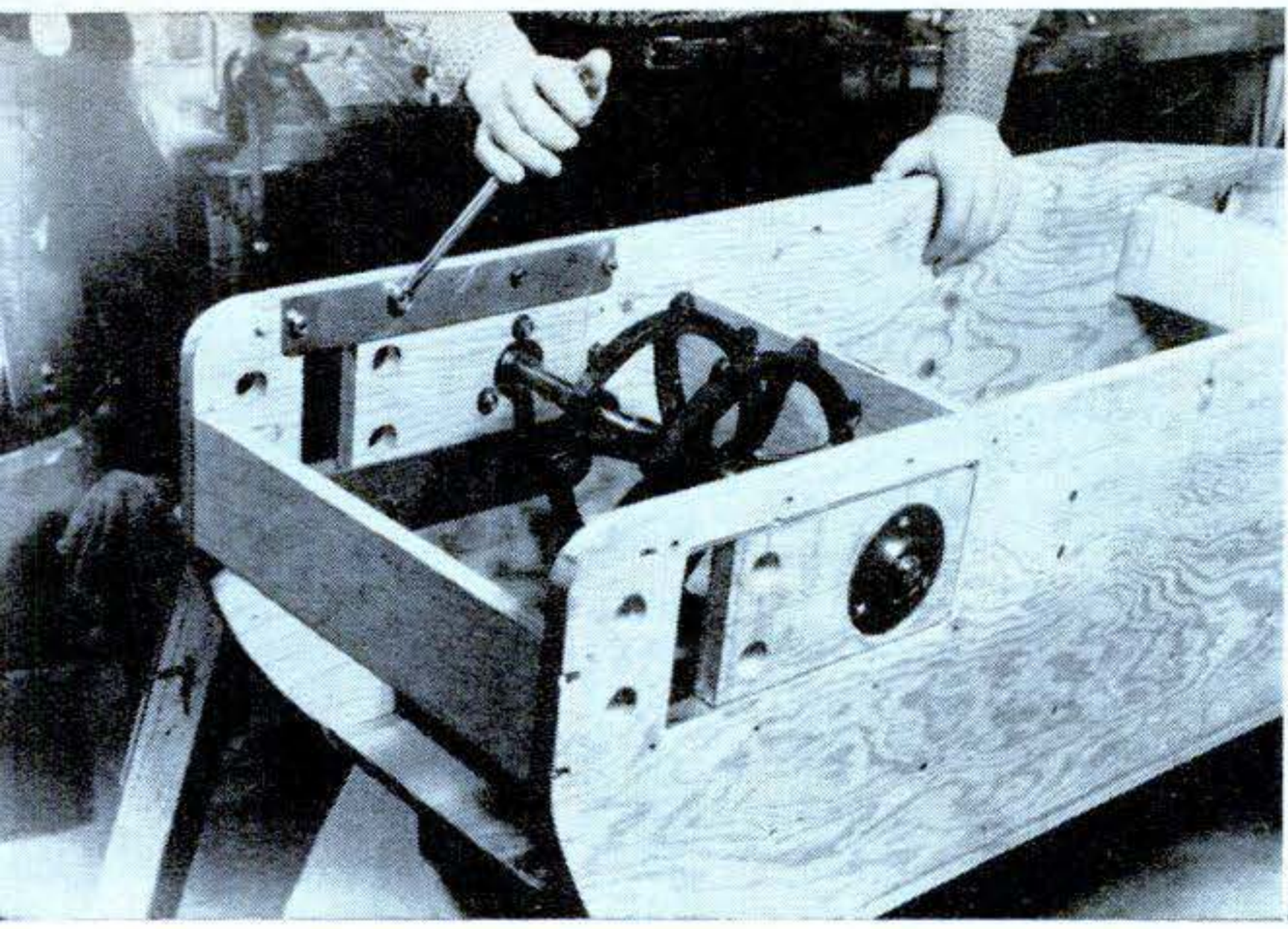
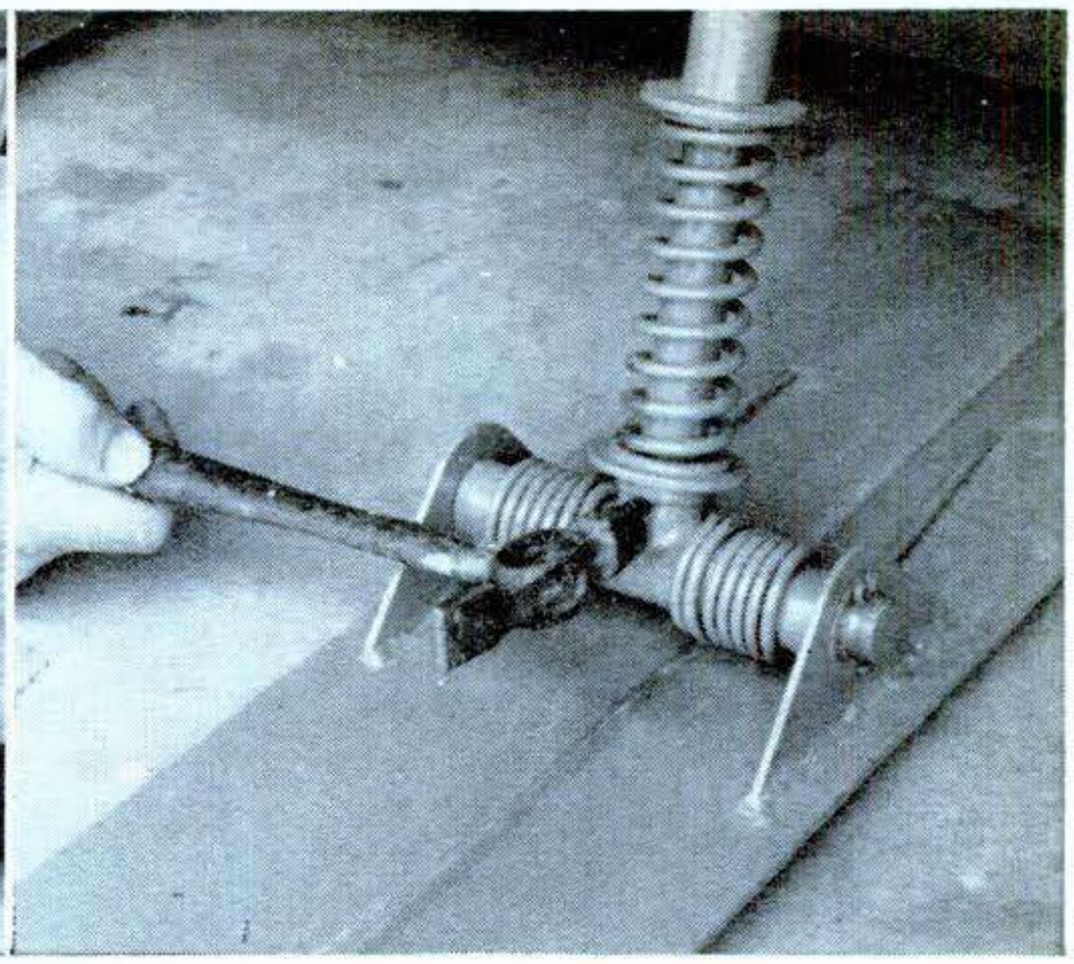
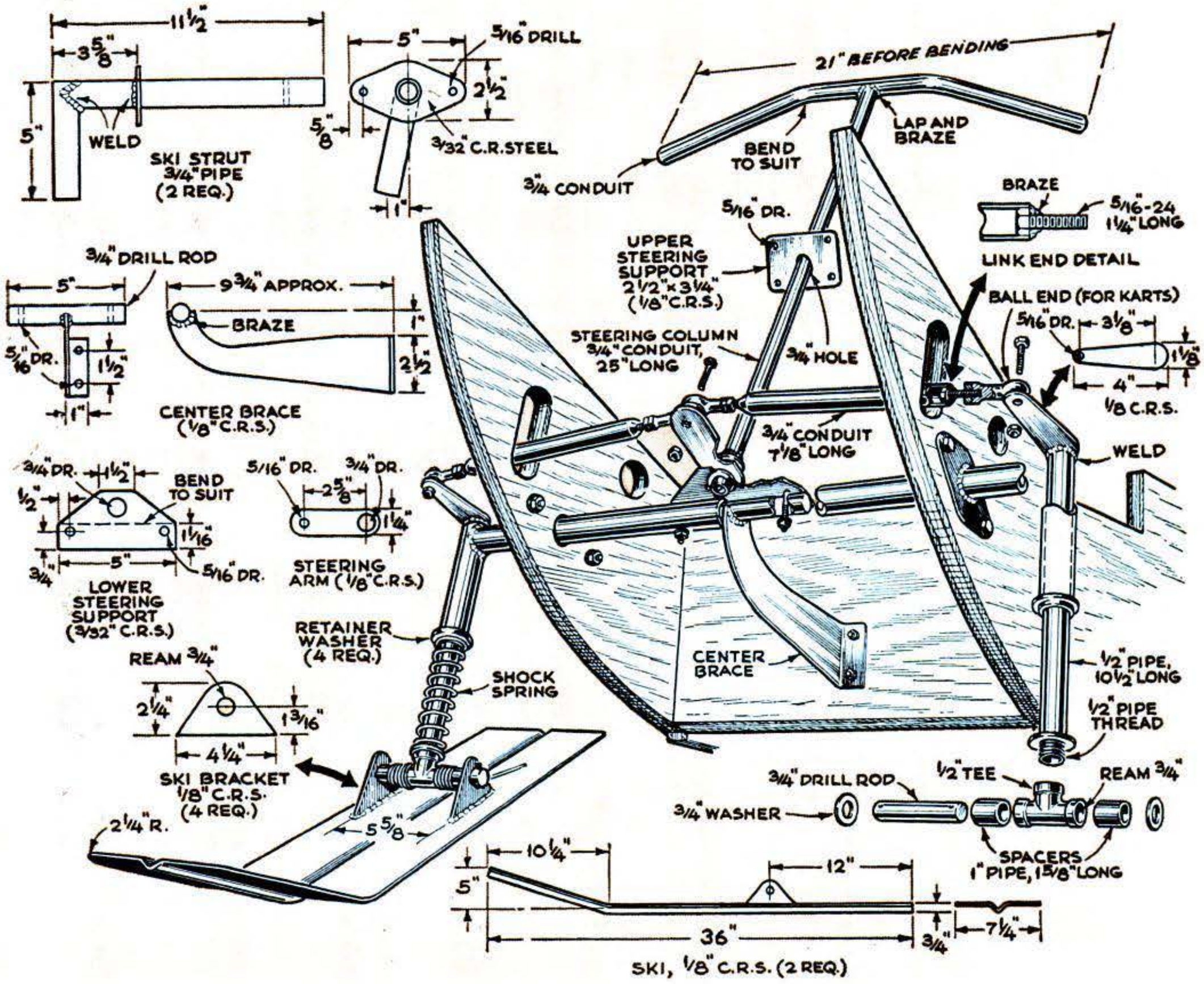


Rear sprocket bearings mount in sliding plywood blocks so they can be adjusted to stretch the crawler track taut. The blocks are held in place by strips of ⅛"-thick steel screwed along the edges of the cutouts in the sides to form retaining flanges. Shock cord is looped through holes in the blocks and holes in the sides to pull the crawler track up tight.



Coil springs slipped over the lower half of the telescoping ski struts act like airplane-type shock absorbers. Crosswise springs—actually hay-rake tines—keep ski tips pointed up so they don't dig in. To prevent skis from twisting on the threaded pipe-tee pivots, locking pins are tapped through drilled holes after skis have been aligned straight ahead.



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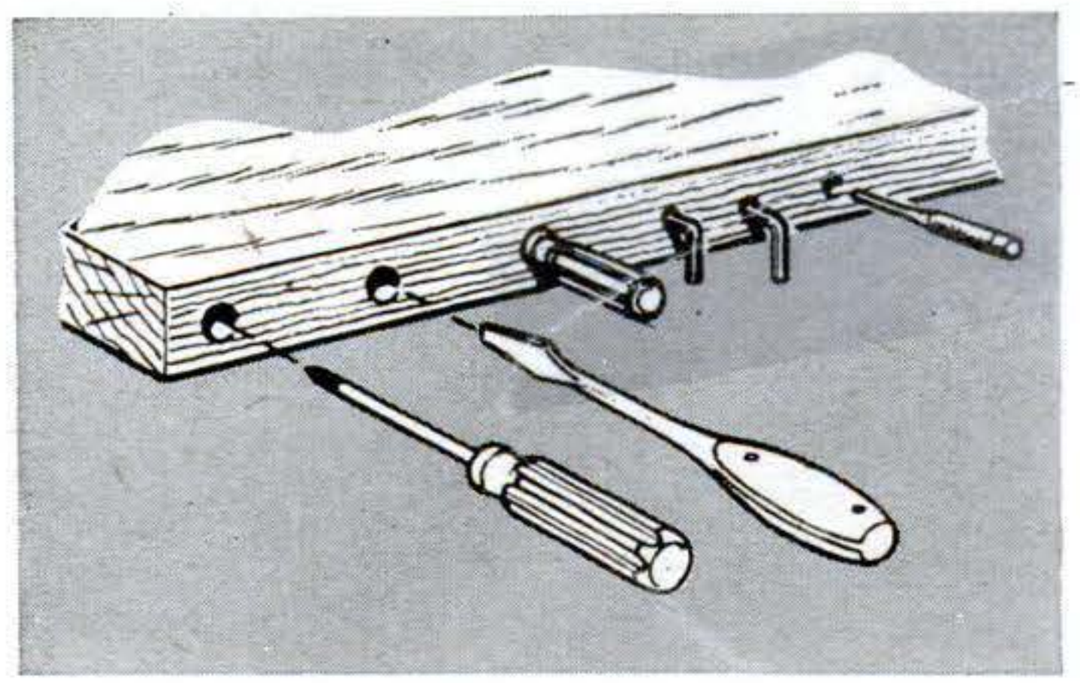
Short Cuts and Tips | FROM PS READERS

Tuft of cord on gun barrel is a fine wind barometer

Ever watch corn tassels move daintily with every wisp of wind while you're out with a gun? You can take a corny tip and improve your aim at long range. Dangle a tuft of cord from your gun barrel and it will swing with the breeze, reminding you to adjust the scope's windage for long shots. It works fine. *—Don Shiner, Nescopeck, Pa.*

Tools in shelf edge save space

Home workshoppers store their smaller tools in a number of ways on the walls and in the bench, but I have found my method the most convenient. I keep the tools in holes drilled into the edge of a shelf above the workbench. Screwdrivers, nail sets, punches, and small setscrew wrenches can all be stored in that way—and you still have space on the shelf itself.*—Warren E. Kraeger, Mineola, N. Y.*



Treads hinged for dead storage

The area behind the basement stairway shown in the photo was made accessible for dead storage by hinging the lower treads to the stringer at one end. A hook and eye holds each tread up out of the way.*—D. W. Vandeven, Syracuse, N. Y.*

Folding doors give privacy in carport

The folding doors shown above were built of cedar and perforated board and installed across the street-side opening of a carport. The doors give me privacy for shop work inside the port, yet let plenty of air through.*—H. S. Oberdorf, Miami, Fla.*

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PHOTOGRAPHICALLY SPEAKING

By Bob Hering PS PHOTO EDITOR

Deluxe mounts make slides that can take it

You won't be rushing out to get all your old ones remounted, but if your slides get hard usage, Eastman has a new laminating service for your next batch of film. The slides are cemented to thin cover glass and mounted in aluminum-and-plastic casings. Advantages: edge-to-edge sharpness for large-screen projection; more efficient cooling; elimination of Newton's rings; no film buckling in high-wattage projectors. Price: $1.50 for singles, $1 each for 100 or more.

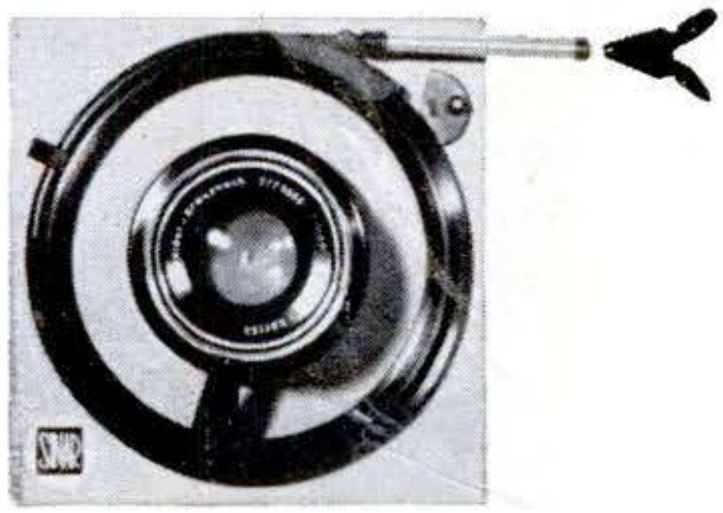
New black-and-white Ansco roll film

Have you heard about Versapan, Ansco's new roll film in 120 and 35mm? Its all-purpose emulsion has a speed of 125 ASA. Even with normal developers the grain pattern is tight, Ansco says. As you extend development, there's a considerable increase in contrast. Its speed and developing characteristics should make it a good choice for speedlight shots and situations requiring good contrast control.

Self-help paperbacks for your library

Some of the best buys in photographic literature are the carefully researched books put out by leading photographic manufacturers. The new *Ansco Guide to Picture Fun Made Easy* (Popular Library, 75 cents) is one of these. This thoroughly indexed paperback offers an easy-to-follow photographic course for the whole family. The book stresses how to tell stories with photographs—suggests hundreds of picture-taking situations. It also includes the basic mechanics of photography, and there's a section devoted to the ABCs of home movies. You'll find the book worth much more than its modest price tag.

Another home-study book is *Self-Teaching All-Camera Photography* by Dr. Kenneth S. Tydings (Photolix, Inc., $2.95). You'll find an extensive program of do-it-yourself projects in its pages. Step by step, it takes you through the fundamentals of available light, floodlights, flash, shutter-speed selection, and light quality. Bound into the book are glassine filing envelopes in which you can place negatives for study and comparison. The book is well illustrated with examples of how to handle your projects.



Now—automation for view cameras

With all the automation around these days, it was bound to come: Even view cameras are going automatic. The new Sinar shutter stops down to a preselected shooting aperture the moment you insert the film holder.

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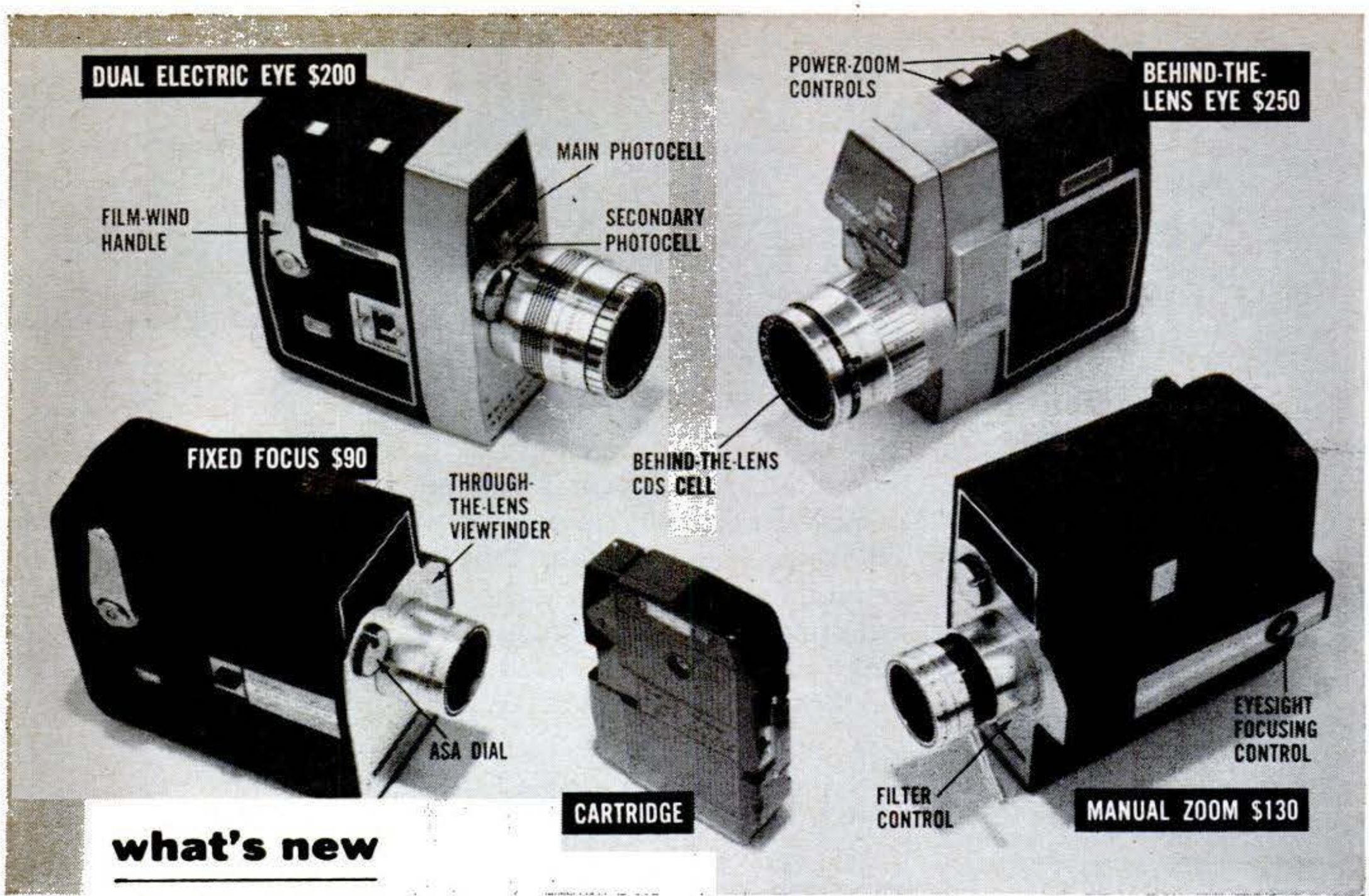
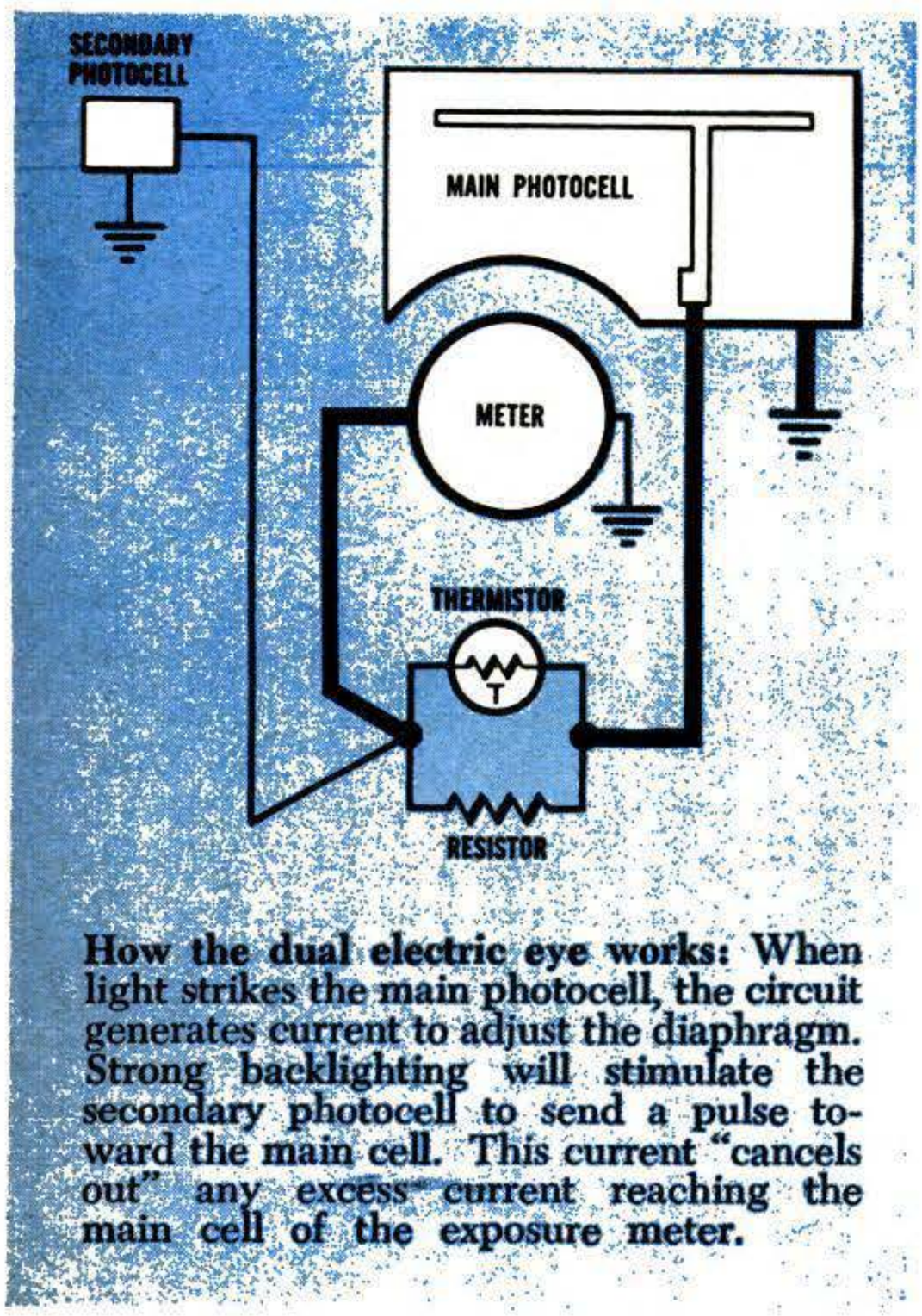


what's new

PHOTOGRAPHY

Easy-Loading Cartridge Movie Cameras



How the dual electric eye works: When light strikes the main photocell, the circuit generates current to adjust the diaphragm. Strong backlighting will stimulate the secondary photocell to send a pulse toward the main cell. This current "cancels out" any excess current reaching the main cell of the exposure meter.

A NEW family of 8mm movie cameras has been introduced by Bell & Howell. Called Autoloads, they have one feature in common: They're all cartridge-loading.

The cartridges, preloaded with regular 8mm roll film, give you the advantage of light-tight magazines with the economy of roll film. After exposing 25 feet, the film counter reads "end," and stops automatically. To change sides, you flip the cartridge and re-insert.

All the cameras have electric eyes for automatic exposure control, built-in haze and type-A filters, and through-the-lens viewing. Zoom lenses are standard on all but the cheapest model; it has a fixed-focus lens. One zoom lens is manually controlled; two are powered (top left and right).

You can switch instantly from normal 16-frame speed to slow-motion 48-frame speed on the two power-controlled zoom models.

The dual-electric-eye camera uses a second photocell to regulate those unusual situations when strong backlighting causes overexposure (see diagram, left).

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So— I Built My Own Fire-place

It's a cinch with one of the ready-made metal forms

By Darrell Huff

FOR real cheer in a home, you can't beat a rugged stone fireplace built around a warm-air-circulating core. Stone stays handsome forever without finish or maintenance. And there's no better do-it-yourself material.

Where an ordinary fireplace heats you one-sidedly by radiation alone, the circulator adds warm air by convection. Merely useful in a house with a furnace, this feature becomes almost essential wherever a fireplace must do the whole heating job.

Basis of the fireplace unit is a double-walled steel firebox. As this heats up, air moves through it by gravity and flows out into the room. Topping the core is a smoke dome with downdraft shelf and damper.

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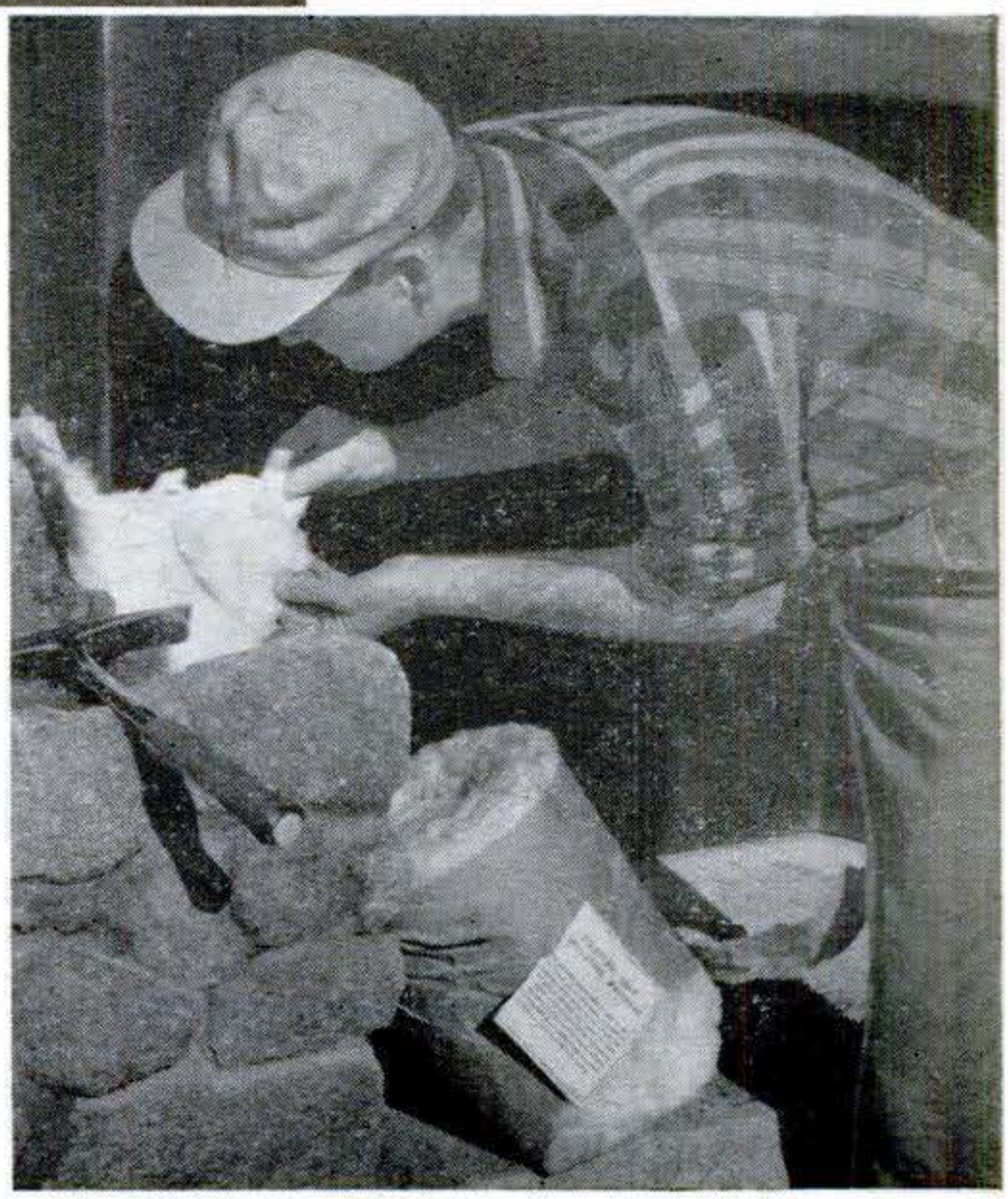

Mineral wool cemented around the steel circulator core provides expansion space between core and masonry. Cement will hold the wool to steel while you put the masonry in place.

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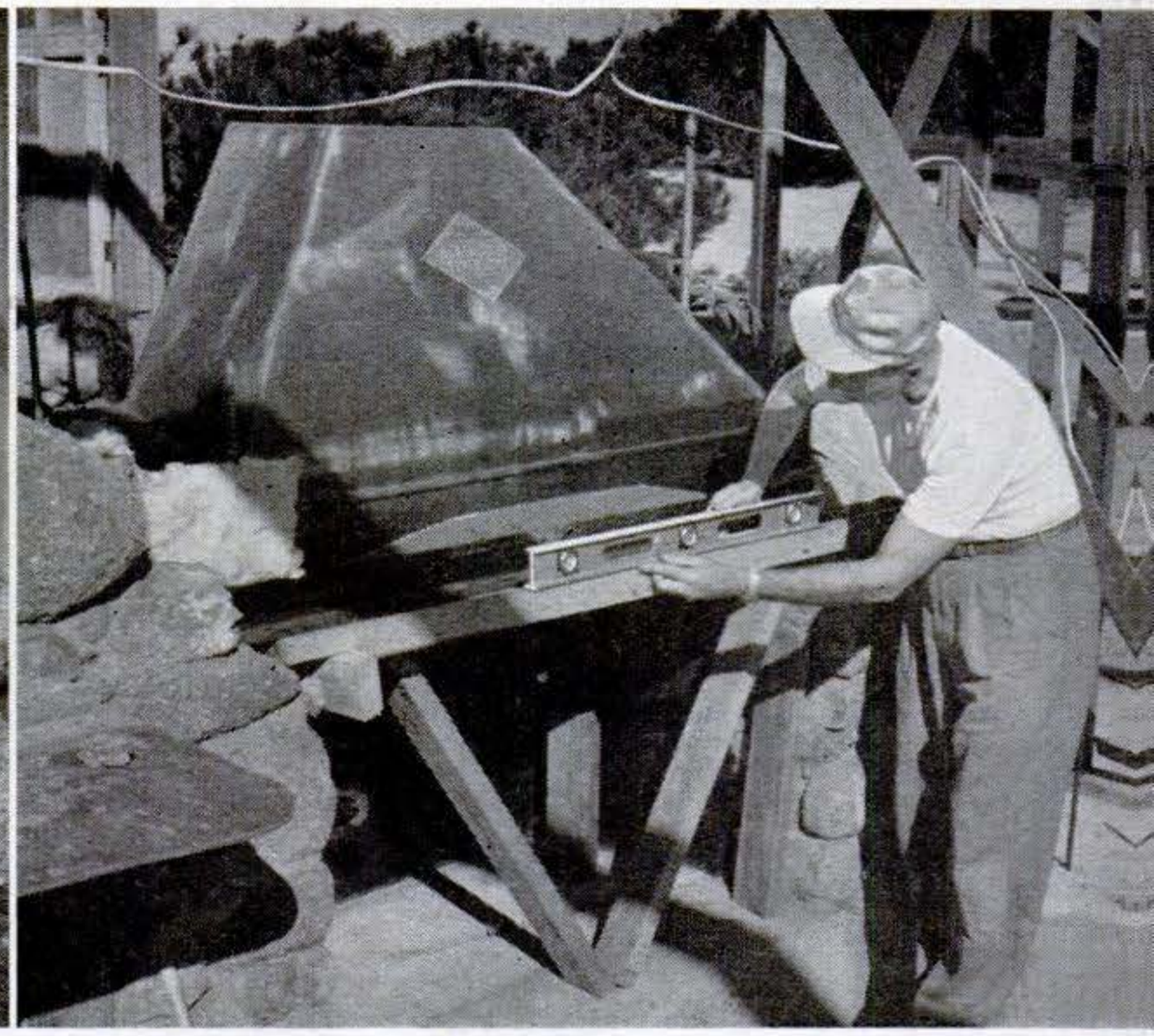
The units are made to give these opening widths in inches: 28, 32, 36, 40, 48, 60. In choosing, consider the size of the room and the length of firewood you'll use.

The foundation. Since you're dealing with a considerable mass of masonry, your fireplace will need a stout slab foundation. This may sit on a concrete footing, or be suspended above it with an ash pit between. In that case you'll want an ash dump in the slab and a cleanout door outside.

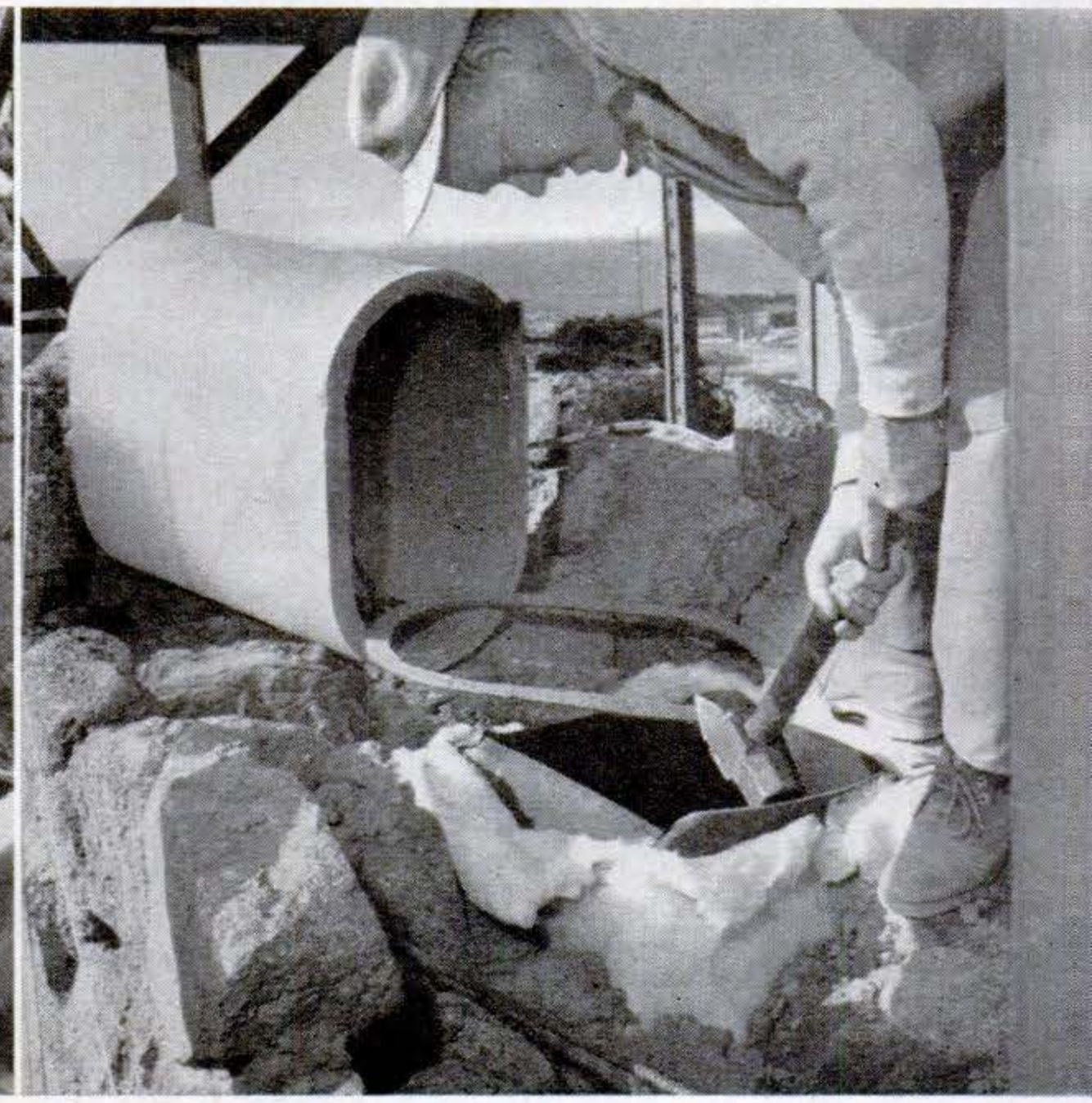
Make your foundation at least as large as

For a rough and rugged fireplace, use fieldstone pretty much as it comes. But choose carefully for fit before setting in mortar. Mason's hammer is quick tool for occasional shaping.



Make fireplace opening an inch narrower than that of the unit to conceal joint. Form shown here supports masonry over opening and braces angle-steel lintel while concrete sets.

Freestanding fireplace in center of building is really a hollow wall of stone with concrete shoveled inside. Wool-covered steel unit acts as form, but masonry must be self-supporting.



Top of dome should be split at corners and shaped to fit inside flue liner. Cardboard template makes this easier, since liner is heavy. Do not bend back of dome, only front and sides.

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the area to be occupied by the masonry of the fireplace. It will have to be from 2′ (for a small unit) to 3′ wide and half again as long as the width of the fireplace opening. That's if you use brick or thin stonework. For other masonry, including fieldstone, figure more generously. The footing below, 8″ to 12″ of concrete, should extend 6″ beyond the foundation.

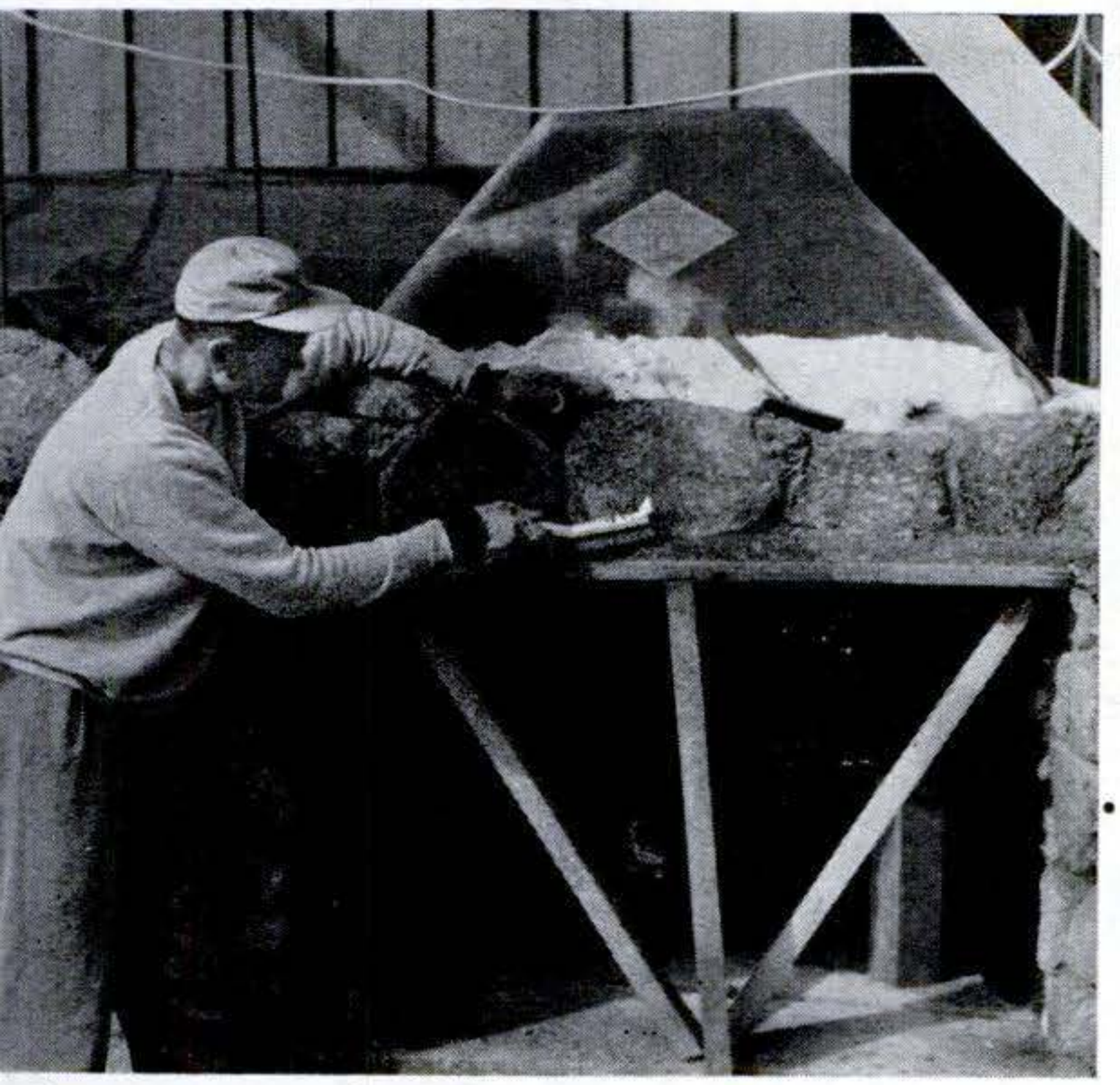
To key the masonry together, embed pieces of reinforcing steel in the foundation. Use at least two ½″-diameter rods.

The facing. Lay up the stone much as you would in building a wall. Simply choose your stones as well as you can for fit, shaping them a bit with a mason's hammer when necessary. Set them in a mortar mix of one shovelful of portland cement to three of plaster sand, plus water.

Fill behind the stone facing with concrete plus any rock you have to spare. Let the steel core act as a form; it should not support any weight except while the concrete is setting. Bridge gaps with pieces of reinforcing steel.

A roll of mineral wool will come with

[*Continued on page 212*]

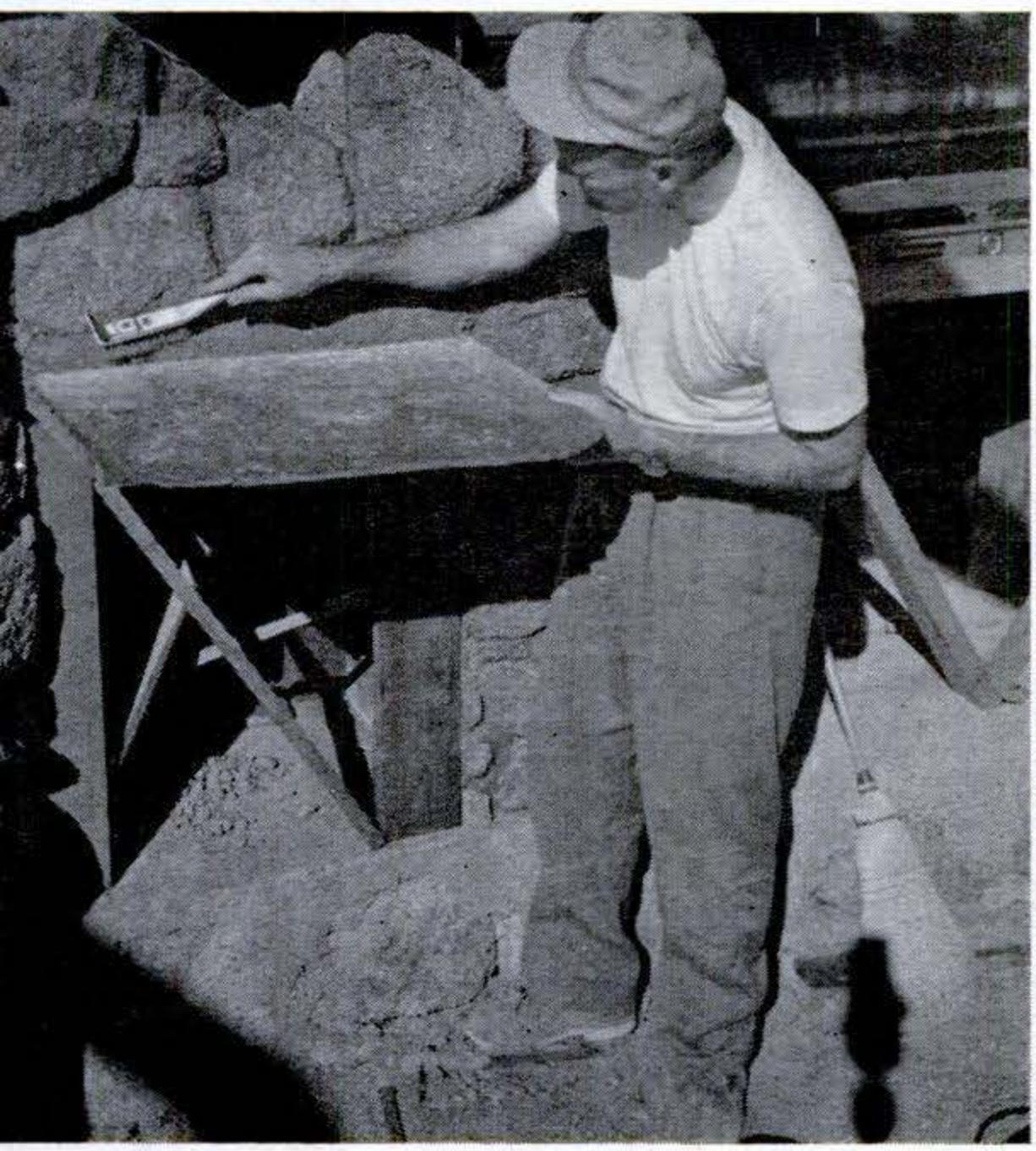


A few inches of concrete with steel reinforcing gives extra strength over openings. Direct-burial plastic cable seen at top of photograph is for outlets and lights in ends and top of wall.

Where to get metal fireplace forms

Your local building-supply dealer can usually show you a selection of preformed fireplace units—or order the one you want. Prices vary widely, from around $70 for a unit with an opening 24″ by 36″ up to about $245 for a large one—36″ by 60″.

Makers include Vega Industries, Syracuse 5, N.Y. (Heatilator); Superior Fireplace, 4325 Artesia, Fullerton, Calif. (Heatform); and Majestic Co., Huntington, Ind.



To build in a woodbox, use plywood forms for three sides. Remove these when top is reached. Boards support removable top form. Wire-brushing gives texture to exposed concrete.

Make ducts in masonry from the four openings in the steel core to the outside of the wall. Mortar grille housing into surface of stone. Screws fasten louvered grille to housing.

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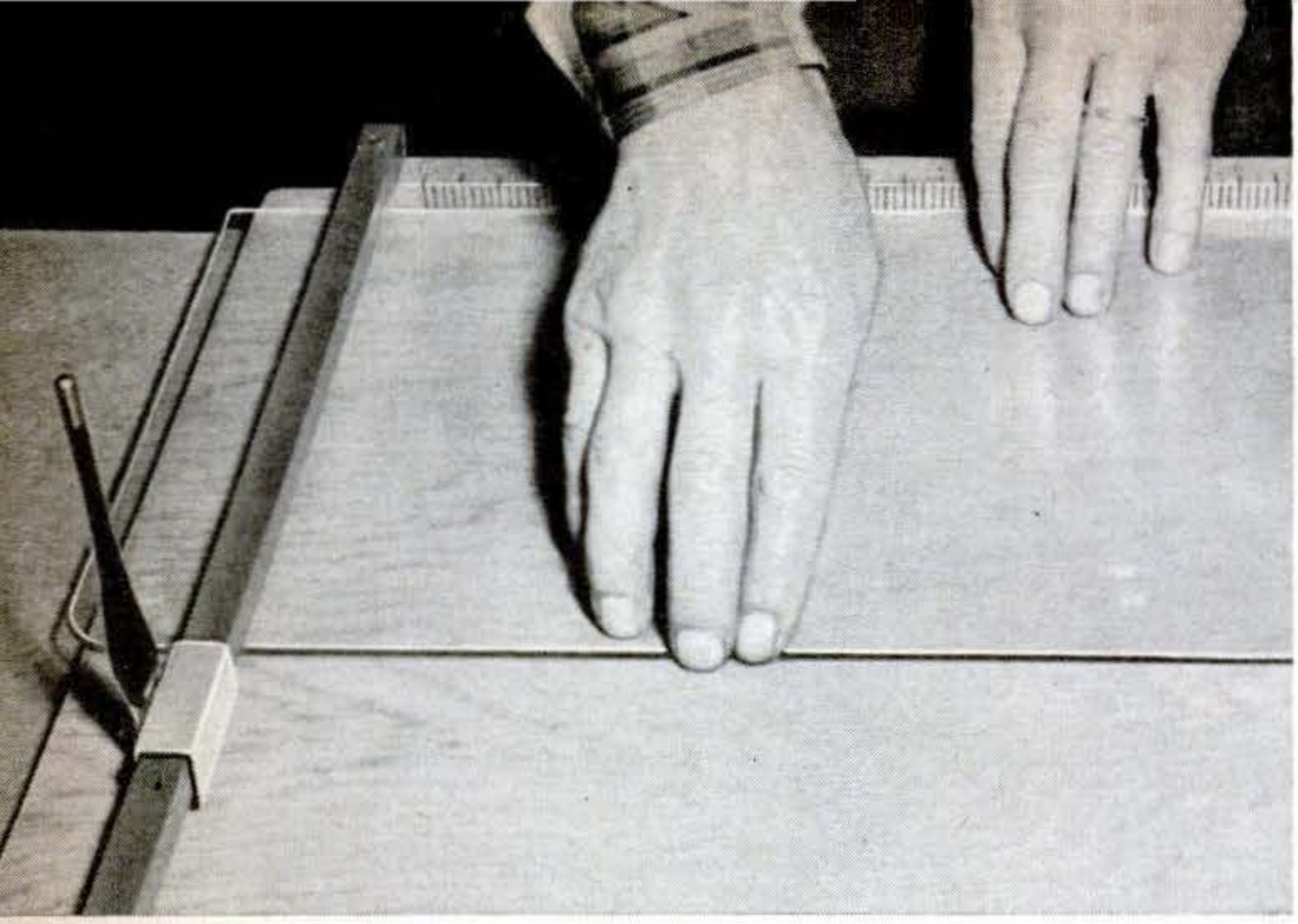
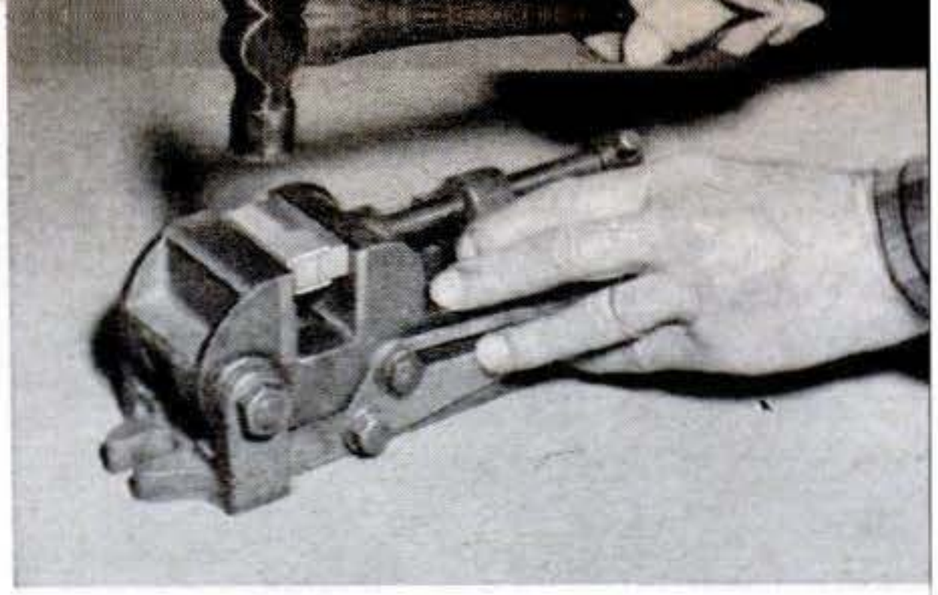
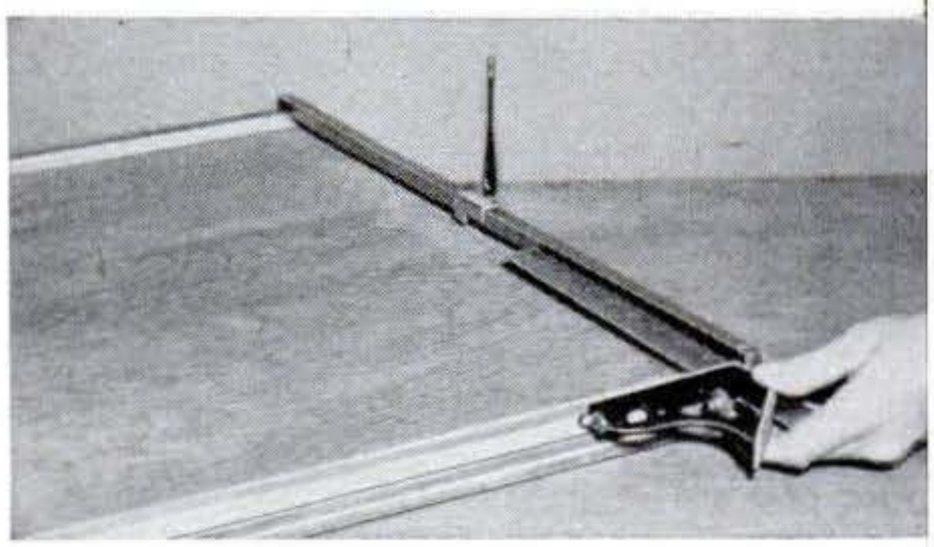
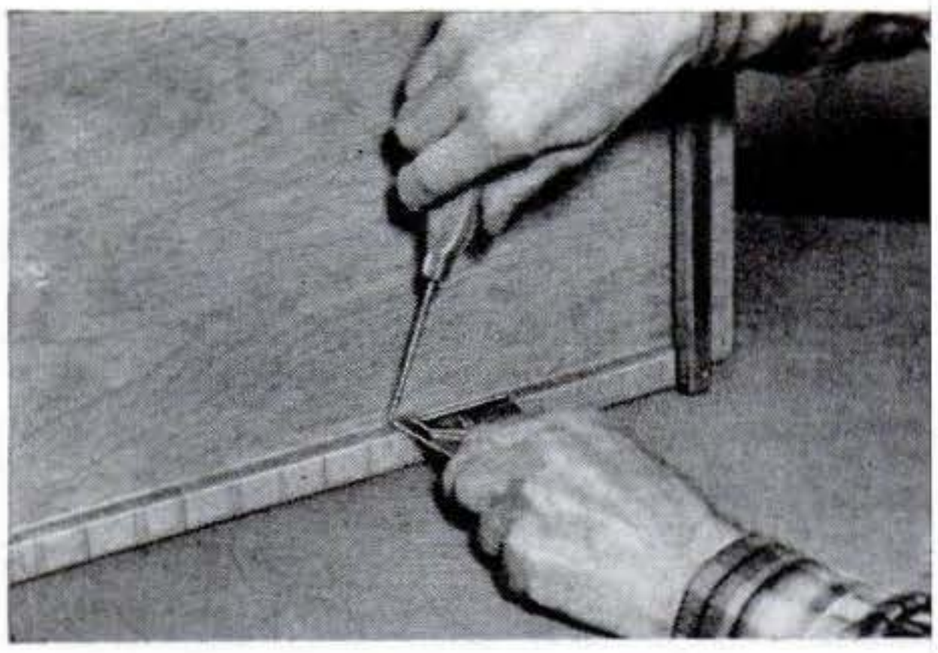




The slide that holds the glass cutter is formed by bending 1/16″ sheet brass over a piece of square steel bar in a vise.



The metal bar is checked with a square to ensure alignment with the front strip. It must be perfectly squared.



The scale on strip is made with small square and awl. Scribe lines at ½″ intervals along top surface, ⅛″ along inner edge.

PS PROJECTS

How to make a Glass-Cutting Board

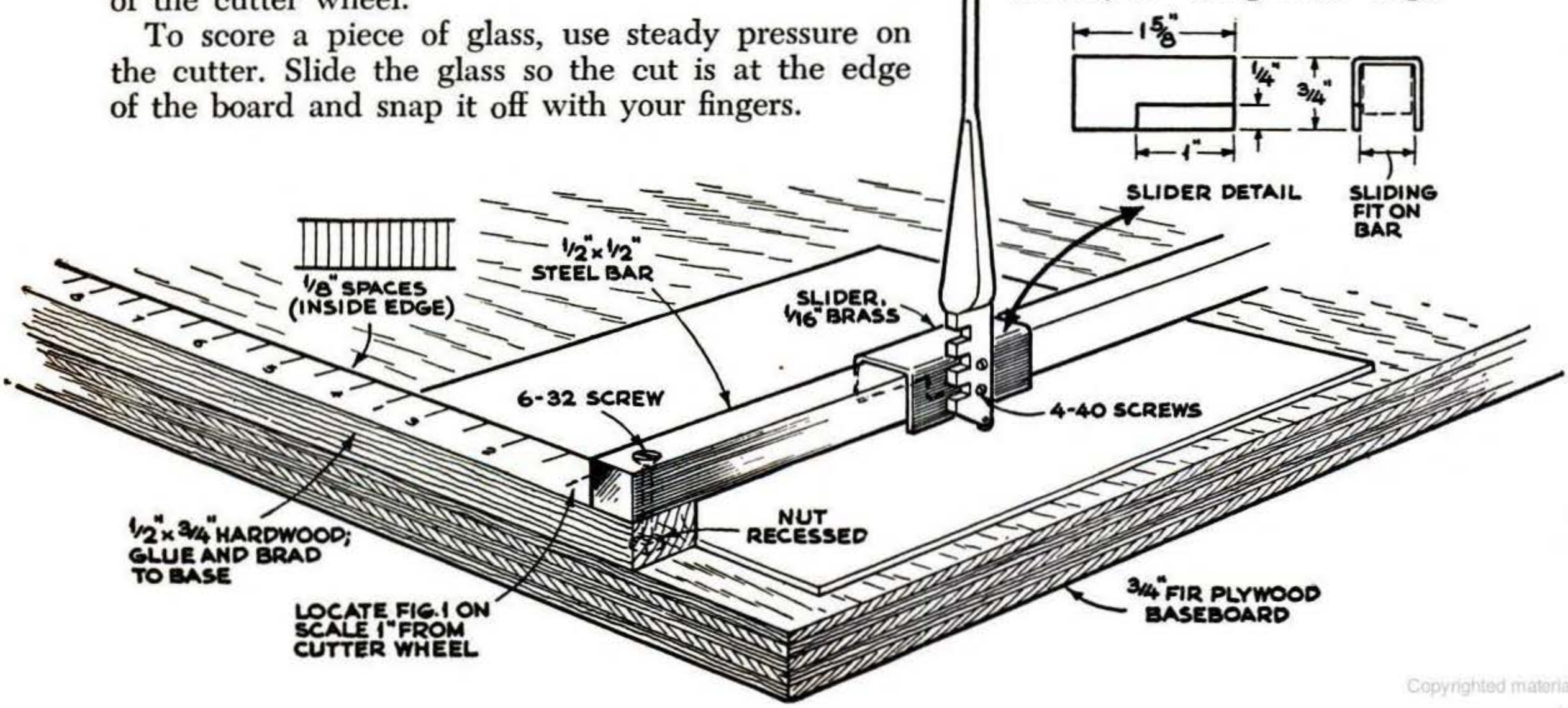
MAKING a clean, accurate cut for a new windowpane is as easy as slicing paper when you use this cutting board. You can assemble it for less than $10 in a couple of evenings.

Begin by cutting the ¾″-plywood base. The 23″-by-24½″ dimensions will handle most glass-cutting jobs around the house.

Attach the hardwood strips at the two sides with glue and brads. Make certain both wood strips are at an exact right angle to the ½″-by-½″ cold-rolled steel bar before it is bolted to them. Next, make and mount the glass-cutter assembly.

With a small square and awl, scribe ⅛″ lines on the inside of the lower strip and ½″ marks on its top. The figure 1 is located exactly an inch from the line of the cutter wheel.

To score a piece of glass, use steady pressure on the cutter. Slide the glass so the cut is at the edge of the board and snap it off with your fingers.



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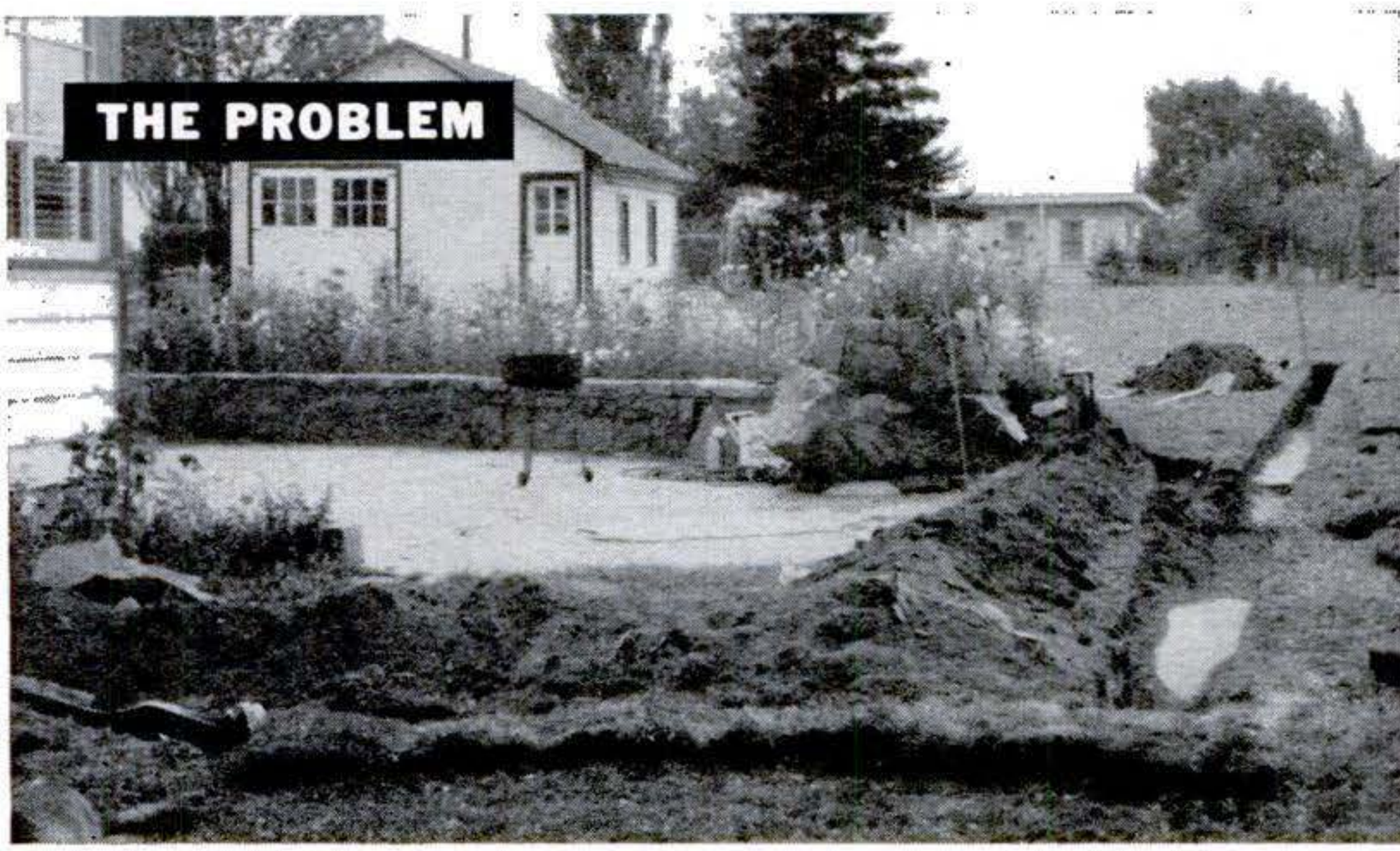
It won't freeze!

Water Pipe on the Rocks

SHALLOW bedrock—great as a patio base—can mean trouble for a water-line installation unless it has two-way protection: insulation and a way of adding heat, automatically, as needed. The solution: Styrofoam slabs and thermostatically controlled electric heating tape.

To find the best path for my line, I drove a metal rod into the ground at intervals, measuring depths. Then I dug down to maximum frost line wherever possible.

My lumber dealer supplied Styrofoam slabs ripped to proper size. I routed a semicircular groove the full length of each strip, using a molding head on my bench saw. I cut the groove oversize, so the pipe plus electric heating tape would fit. A built-in sealed thermostat, located at the coldest point in the line, is set for a 34-40-degree temperature range.—*E. William Austin.*



Best path between house and water supply bypasses as much bedrock as possible. Locate it by "rodding" the area. Dig a trench 12″ to 18″ wide, shoveling below the frost line wherever possible. Clean out the ditch and level it with fine fill dirt. Then make your pipe connections between the house and water source, checking for leaks before covering.

Run heating tape along side of the pipe, fastening it every 6″ or so (below, right) with a turn of electrician's tape. Beginning at one end of your line, sandwich Styrofoam around the pipe (left photo), butting ends tightly. A few strips of pressure-sensitive cloth tape will hold the top and bottom of each sandwich until you backfill the trench.

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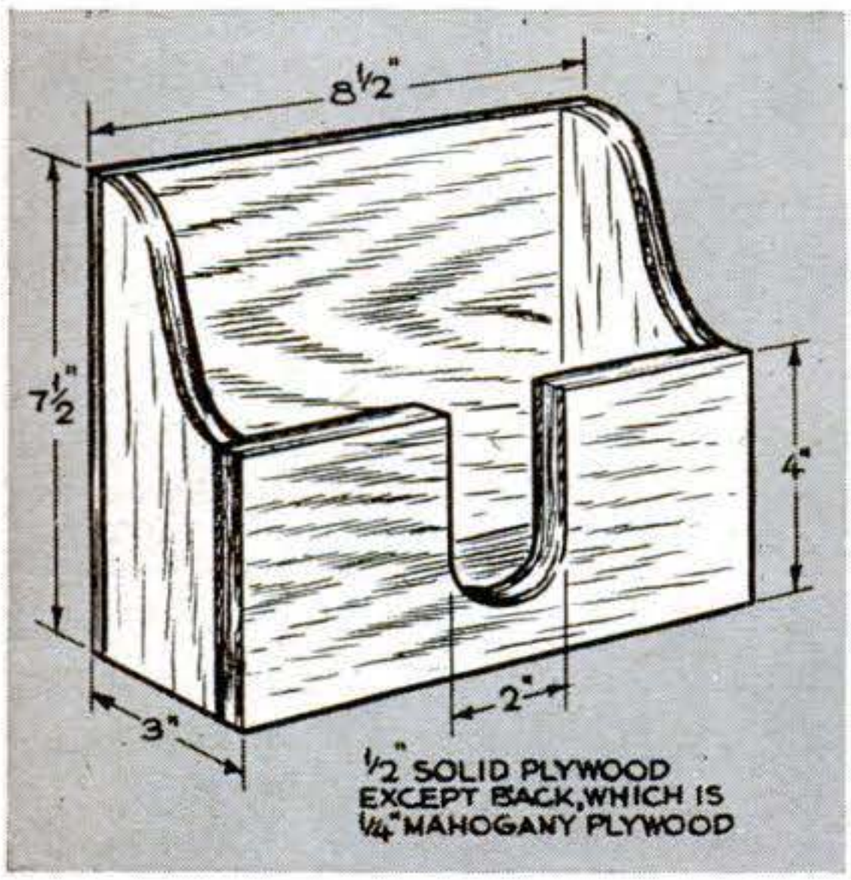
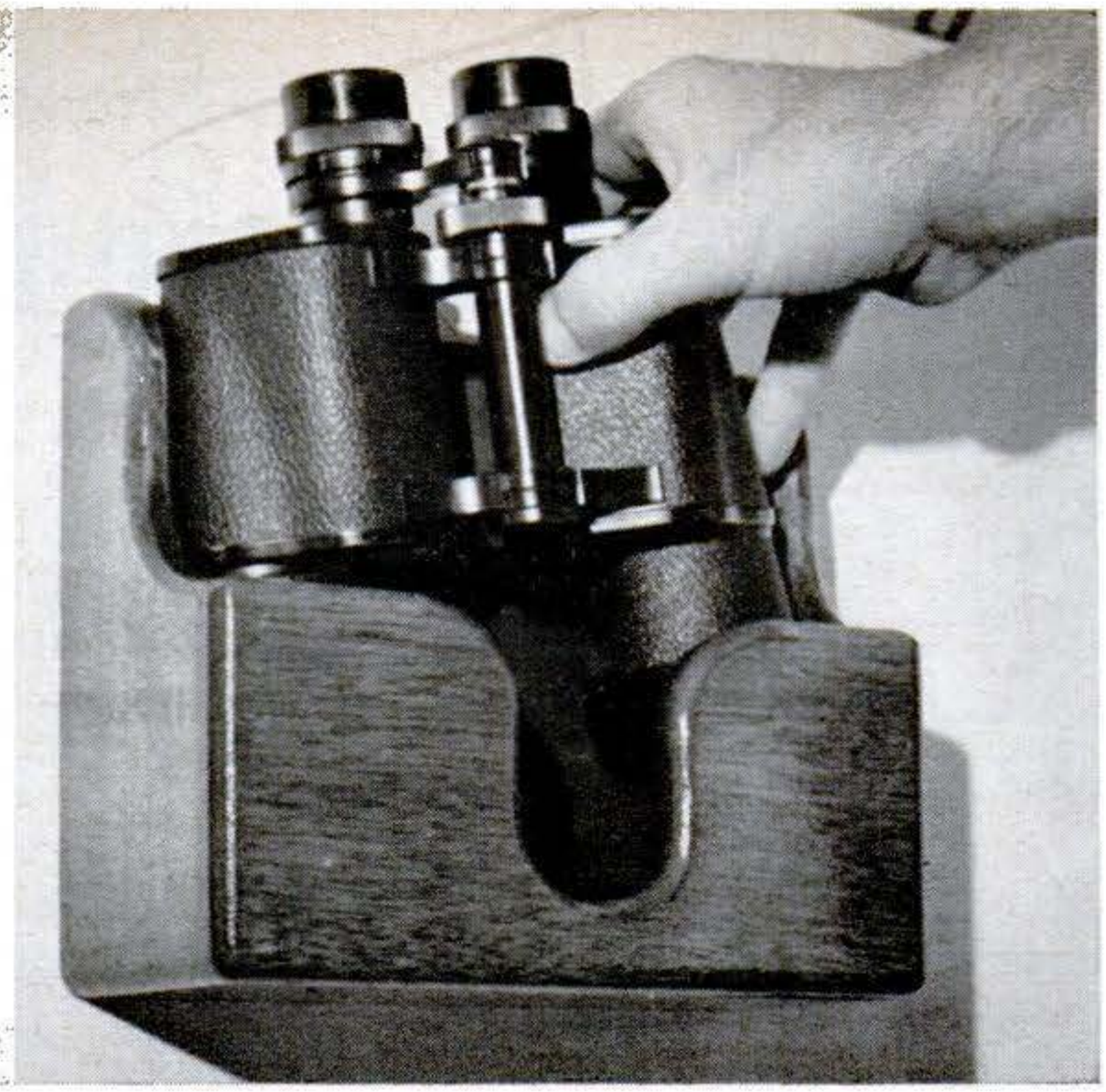
Short Cuts and Tips | FROM PS READERS



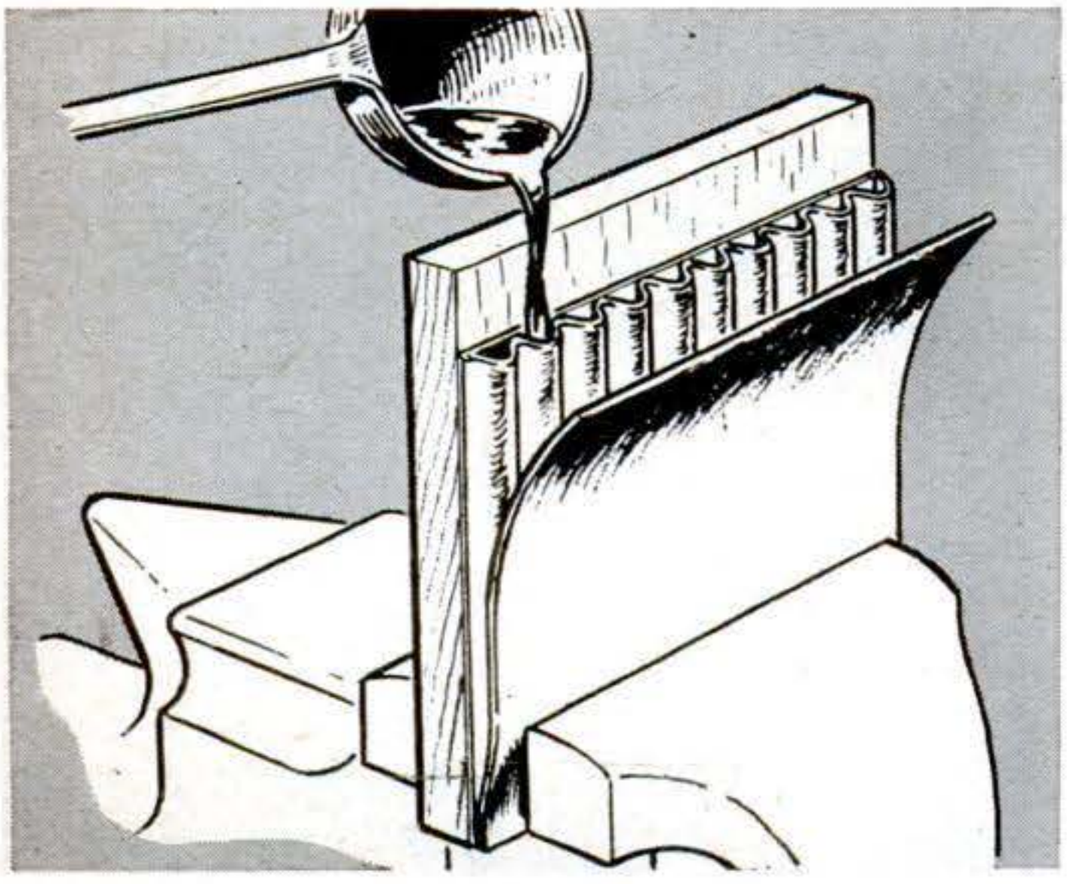


Easy-to-make binocular rack

You can assemble this mahogany binocular rack in an evening and get years of service from it on a boat. Join the five parts with marine glue and brads. Finish with a spar varnish, and put felt on the bottom to protect the glasses. Mount near the helm in a spot that's free of spray.—*V. W. Kondra, Temple City, Calif.*

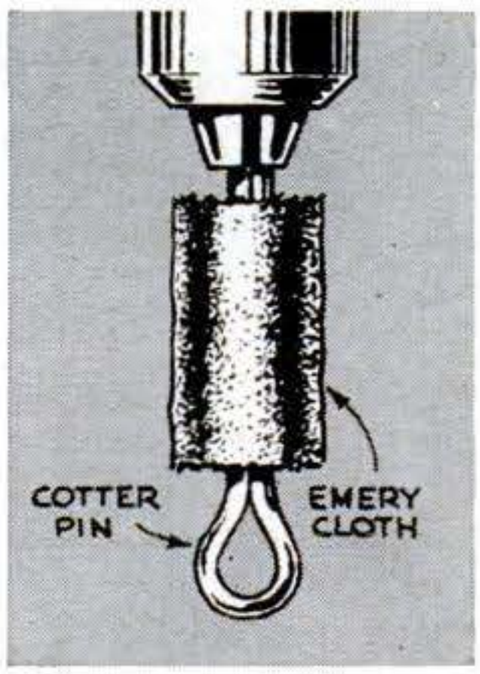
Solder bars formed by corrugated paper

Here's a trick I use to make small solder bars, convenient for finicky hi-fi-kit soldering. Tear from a corrugated box a piece about 10″ long and a little wider than your vise jaws. Lay it on a board and clamp the two in the vise about ¾″ from the bottom. This closes the end so solder can't run through. Open the top to make a lip-and-funnel arrangement (sketch below) for pouring the melted solder into the tubes. After giving the solder ample time to cool, drop the form in water. When the paper softens, the sticks can be lifted out.—*W. J. Perrine, Washington, Ind.*



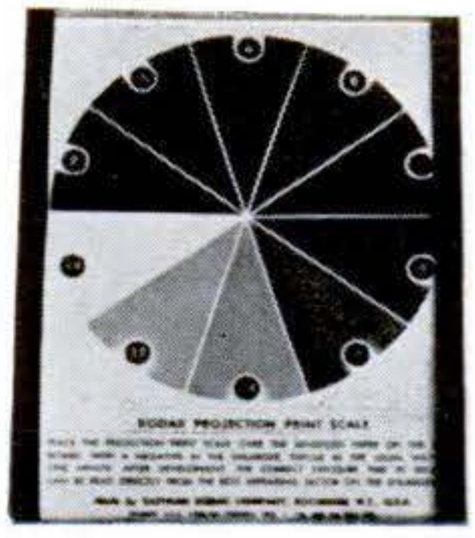
Easy-to-make honing tool

Need a honing tool in a hurry? Slip a 1″-wide strip of emery paper into the slit of a 2¾″ steel cotter pin. Give the paper several clockwise turns around the pin. Put the straight end of the pin into the chuck of a ¼″ electric drill. Tighten, turn the drill on, and you're ready to hone. Good for work on the car.—*H. C. Higdon, Pensacola.*



Glass holds print scale flat

A projection print scale is a useful enlarging aid. But the tendency of the plastic to curl, coupled with the curl of the test paper, sometimes makes it hard to handle. I overcame this by taping the scale to a piece of plate glass. The heavy glass holds both the scale and the test paper flat.—*W. G. Waggoner, Sacramento, Calif.*



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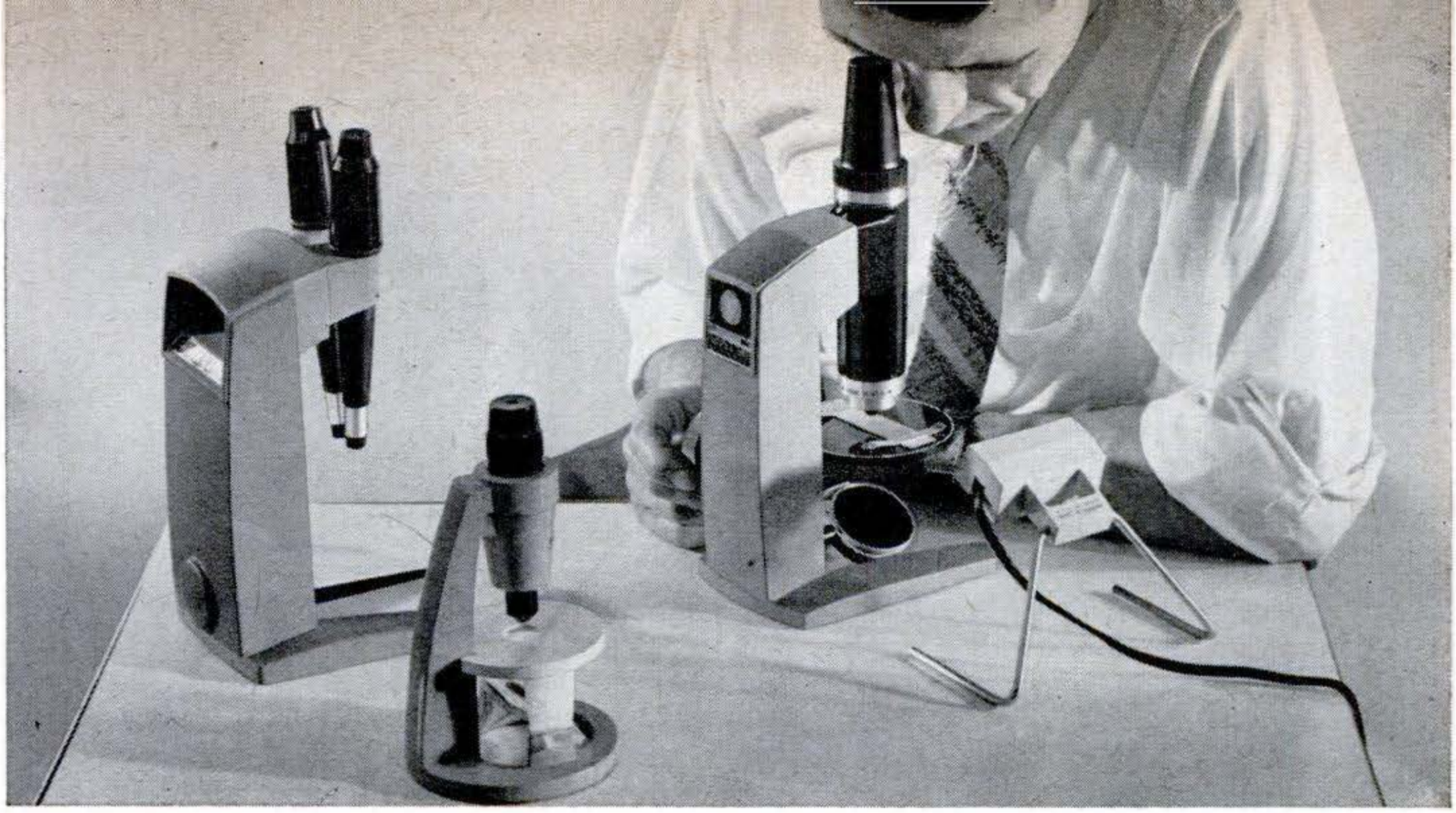


Rugged New Low-Cost Microscopes

ONE of science's basic tools, the microscope, has been given a new look and a new price tag. Bausch & Lomb, an old hand at manufacturing quality microscopes, has introduced a new line of scopes designed for home and classroom use.

Attractive and rugged, the new instruments are designed to withstand daily use by students. The beginner's scope (above, center) is priced at $12, and the advanced models, the ZoomScope (above, right) and Stereomicroscope (above, left), are $50 each. Some of the finer adjustments are omitted but nothing is sacrificed in optical quality. In the lowest-price model several parts are made of durable plastic instead of metal.

All the scopes have nonremovable eyepieces as well as sealed objective lenses.

The $12 scope is offered in two models; one has a 10X power, the other, 100X. The circular stages have white reflecting surfaces for examining opaque materials, and apertures for transmitted light.

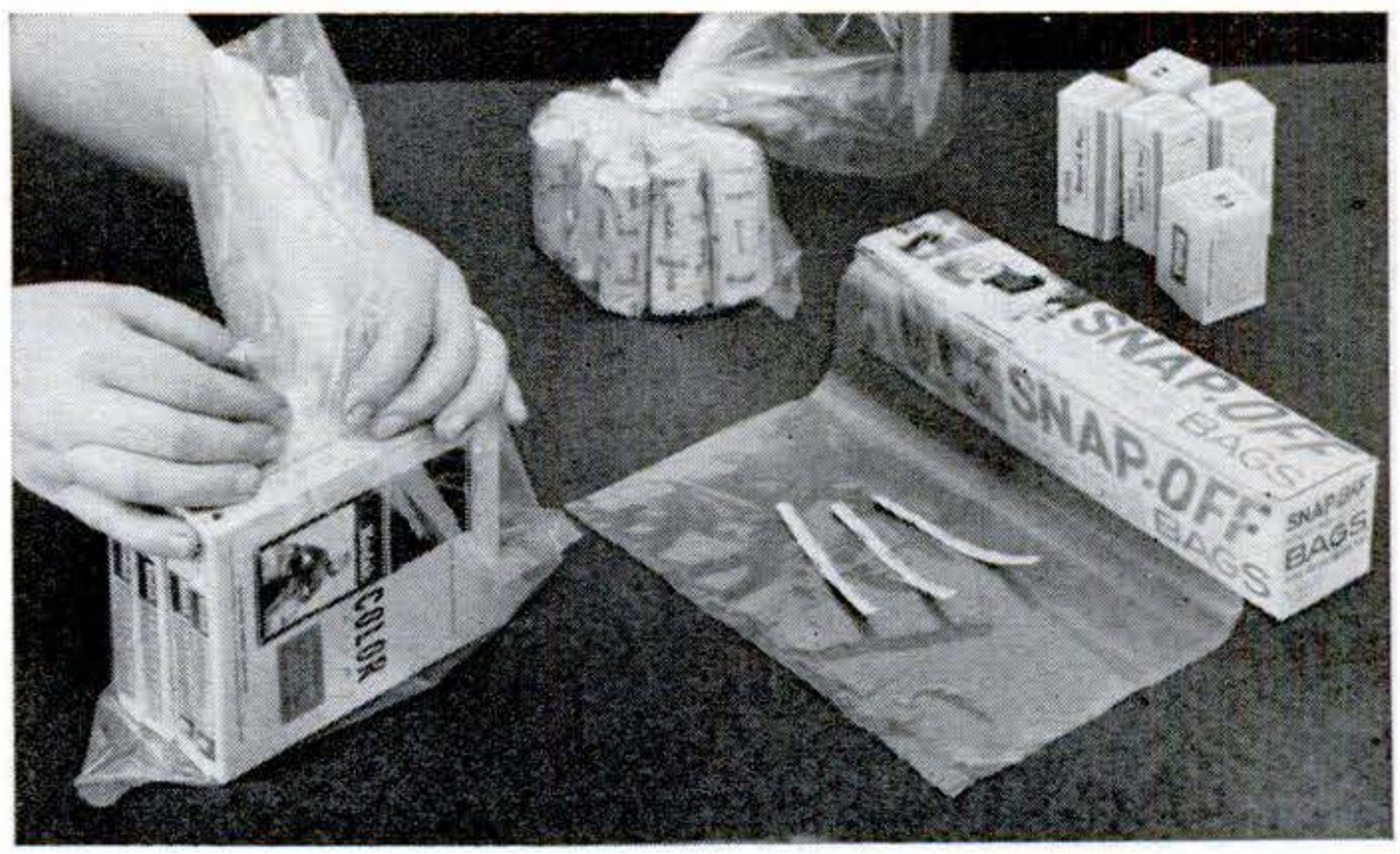
The ZoomScope offers continuous variable magnification: one from 25X through 100X, the other from 50X through 200X.

The Stereomicroscope gives the three-dimensional effect that is needed for inspecting whole subjects, such as small animals and seeds. The scope consists of two microscopes side by side. Since a three-dimensional effect exists at low power only, it uses 15X magnification.

A low-cost ($3) microscope viewing light gives uniform illumination for close work.

Plastic bags keep camera supplies clean and dry

Those little plastic food bags are handy for toting camera supplies on vacations and outings. I not only use them to keep my camera supplies clean and in order but also to protect equipment from scuffs and scratches and still see the contents at a glance. I also use them for storing film in our refrigerator.—*Rudy Schulze, St. Louis.*



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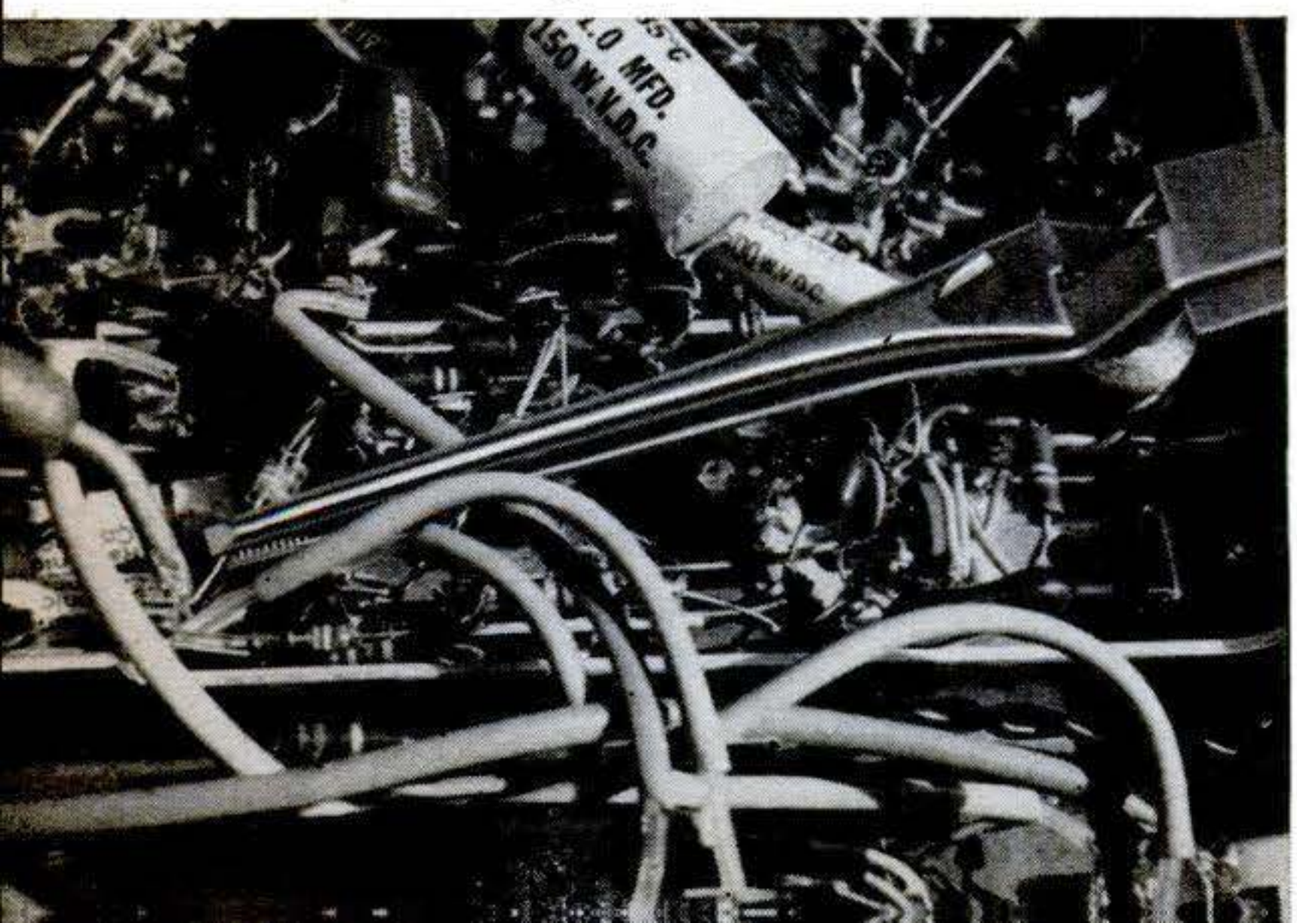
How to get started

Building HI-FI KITS

The tools you need for assembly of hi-fi kits (reading clockwise from the three screwdrivers at the bottom of photo above) are: wire strippers, nut driver, wire cutters, needle-nose pliers, end cutters, soldering iron, self-closing tweezers, forceps, and a coil of solder (center). Below, self-closing tweezers can be used as a heat sink to isolate heat-sensitive part from the heat of a joint being soldered.



By J. Richard Thomson

A QUALITY high-fidelity system costs money, however you buy it. But the best buy, relating quality to cash outlay, is the quality component system built from kits. Since you save the manufacturers the cost of labor, you can expect to pay only a third to two-fifths of what you'd pay for comparable equipment purchased factory-wired.

To do the job, you need moderate patience, average manual dexterity, and a disciplined willingness to follow instructions. The construction manuals packed with kits are complete and clear. They assume nothing. And quite aside from the savings, kit-building will whet your sense of accomplishment, the pride of saying, "I built this!"

Speaker kits are the easiest of component kits (unless we consider the child's play of setting up a record changer in the factory-specified wooden base). Virtually no wiring is involved, other than attaching speaker leads to the speaker terminals. The job is mostly assembly of precut parts, gluing, and placement of screws in predrilled holes.

The power amplifier requires soldering, a technique that usually comes naturally, although experience makes a difference. If you're dubious about trying it, remember that virtually all soldering in factories is done by women. In a power amplifier, you have considerably more tolerance for the first attempt. There is less tolerance in construction of a pre-amplifier and still less in a tuner. Before attempting a multiplex tuner, you should acquire some soldering and wiring experience on power-amplifier and pre-amplifier kits. Sound soldering hints are usually provided by the manufacturers of first-class kits.

A factory-wired unit reflects experienced and quality workmanship. Factory quality control insures this. As a kit-builder, you probably have one advantage over the factory technician—*time* to give to good workmanship. Two factors contribute to quality construction: 1) Adequate tools and 2) the desire and determination to work to high standards. The tools for quality construction are, for the most part, basic and relatively inexpensive ($25-35). Kit-building experience without the desire for quality begets only low-standard workmanship; the desire for quality makes you conscious of former mistakes and helps you recall hints, techniques, and ideas from articles like this.

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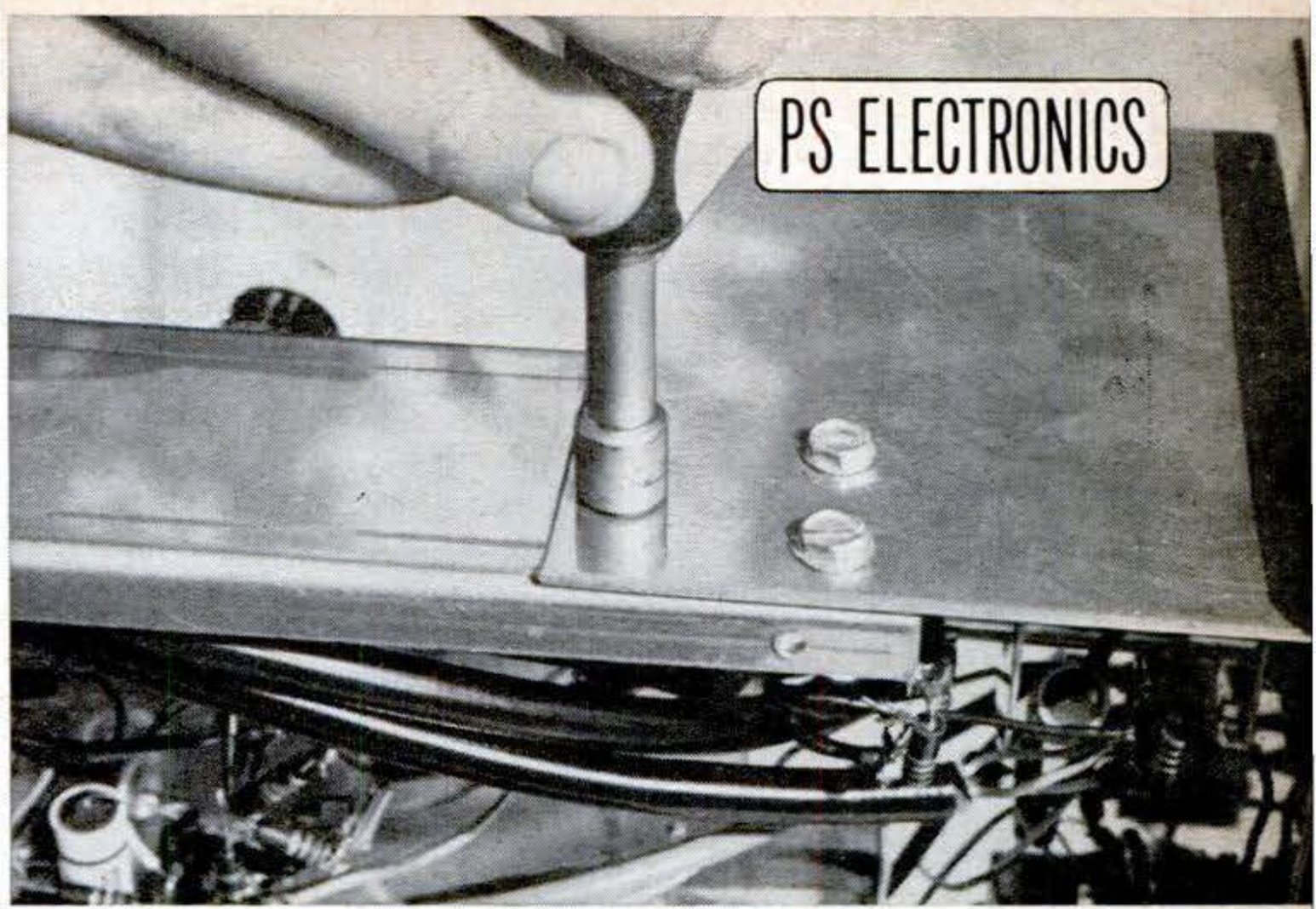
The basic tools. A 150- or 200-watt soldering gun or iron is occasionally needed for a chassis-ground connection. However, the most useful tool for soldering kit connections is the pencil-type soldering iron. The 47½-watt Ungar element with screw-in type replacement tips is most adequate for general work. For delicate jobs, such as soldering the fine wires of tone arms to the lugs that connect to the phono cartridge, an element of lower wattage is better (37½ watt or lower). A wide variety of tips and heating elements is now available for varied applications.



Nut drivers in a selection of four or so sizes are comparatively inexpensive and speed up the job, especially in spots where you'd have trouble working with pliers, even needle-noses.

Self-closing tweezers are useful for holding nuts in tight places while removing or placing a screw, for retrieving a lost item from deep in a crevice of a chassis, for a unique third hand during complicated soldering operations or a heat sink to protect delicate components such as transistors or diodes while soldering. The heat, working its way up the wire from the hot solder joint is dissipated in the heat sink and not transmitted to the heat-sensitive part.

Forceps are used for numerous odd jobs, most of which will be apparent and spontaneous—just have a pair handy on the workbench when you assemble your next kit and notice how often you reach for them.

Screws with different sizes and types of heads naturally require different sizes and types of screwdrivers. A set of four screwdrivers with 3/32", ⅛", 3/16", and ¼" blades should cover practically any kit-building need. You'll want, too, a set of Phillips screwdrivers, sizes 0, 1, and 2 for applications likely to arise with the Phillips-head screw. For tiny screws encountered in installing phono cartridges and setscrews, a set of fine-blade jeweler's screwdrivers are indispensable.

Neat wiring, with squared and straight connections, always gives an impression of quality construction—and the beginner should remember to strive for this. Doing so, you'll find that you end up with an assembly more likely to function properly. Kit-building experts will tell you that spacing and bending of wires can be accomplished best before you begin soldering.

Adjustable wire strippers save a lot of time and injured fingers. Some shop technicians still use oblique cutters to strip insulation, but it is easier to learn to use wire strippers.

Numerous applications in kits require nut tightening or removal in places that will not accommodate a pair of pliers—even the needle-nose variety. This is the place to use a nut driver. Practically all applications can be covered with four sizes: 3/16", ¼", 5/16", and ⅜". The time they save is well worth the modest investment. The recent plastic tube-type nut starter (furnished in Heathkits) works amaz-

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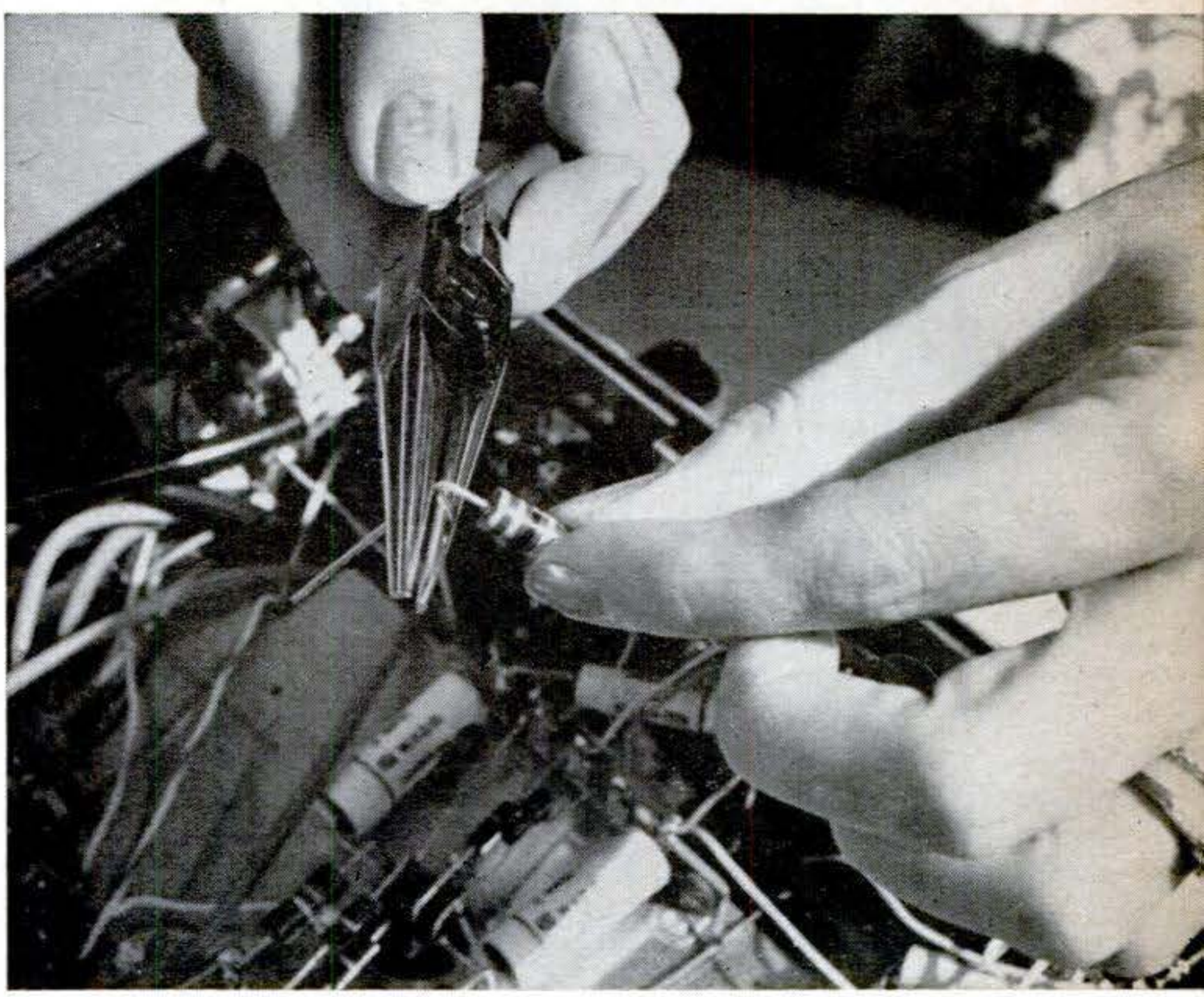

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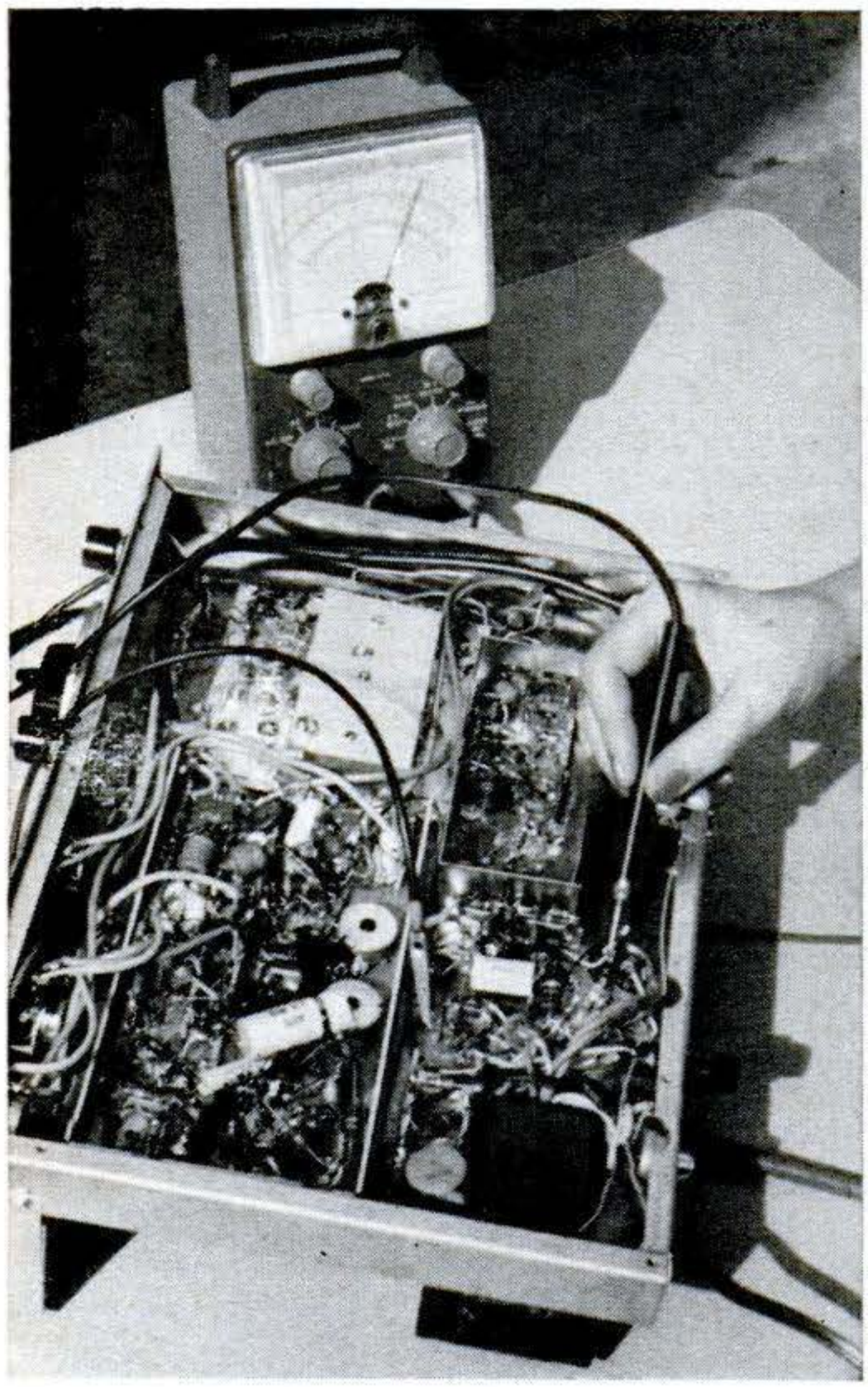
ingly well. This is one tool that is exclusively for kit *building;* it is useless for dismantling.

Since wires are precut in some kits (Scott and Knight, to name two), wire cutting is reduced somewhat. However, you still must make cuts. Oblique cutters, also called diagonals or side cutters, are best. The 5″ needle point (as distinguished from the broad, blunt cutters) appears to be most universally accepted for kit-building.

One of the most useful tools on any bench is a pair of needle-nose end cutters made by Industronic (#S739-6). The cutting edges are located at the point. This allows one to make a close cut deep in the interior of a chassis. These end cutters are particularly good when you tear down a piece of equipment to salvage parts.



Before you progress very far in hi-fi kit-building, you'll realize that there's at least one electronic test instrument that helps you do a better job—a vacuum-tube voltmeter, shown in use above. In fact, the kit makers have found that a VTVM is frequently the first non hi-fi kit assembled by audio enthusiasts. As construction of your kit progresses, be sure to check all of the soldered joints for tightness and freedom from interference by any of the various parts.

The one electronic instrument most useful in quality kit-building is the vacuum-tube voltmeter. For verification of manufacturer's specifications, measurements of resistance, continuity checks, and voltage measurements, a VTVM is practically a necessity.

Dynakit has been furnishing, with the instruction manual, a photograph of a well-constructed kit of the same type being built. This involves an insignificant cost and draws special attention and interest toward quality workmanship. Most builders have never seen the general layout beneath the chassis of the kit being constructed and a picture of a neat wiring and placement job serves not only as a guide to component placement, but as a challenge to all constructors to do the job well.

At the risk of overdrawing the picture, I'd like to make one last point aimed at quality workmanship—squaring off resistor and condenser connections. While this may not make the unit work better, nothing creates such an impression of quality construction as neat wiring. Some builders even use extensive wire harnesses or bundling of wires going to the same general location but this customizing may cause hum or interference in certain circuits.

Unless you have abundant time and patience, plus a knowledge of electronics sufficient to put only compatible wiring together, you are best advised not to overdo a good thing. Every kit manual is emphatic about following only direct instructions. This is of prime importance. The point is to obey these instructions to the letter—*but neatly*. An orderly appearance promotes accuracy in wiring and simplifies rechecking the circuits after completion. You can quickly spot a misplaced condenser, for example, if you mount all such small parts so the values can be easily read. Attention to small details can also save time and money later if you have to replace a burned-out or faulty part. And when the unit is completed, you will be proud to turn it upside-down to show your work to your friends and you will never be ashamed to take it to an audio technician if a time comes when it needs service beyond your repair ability. ■ ■

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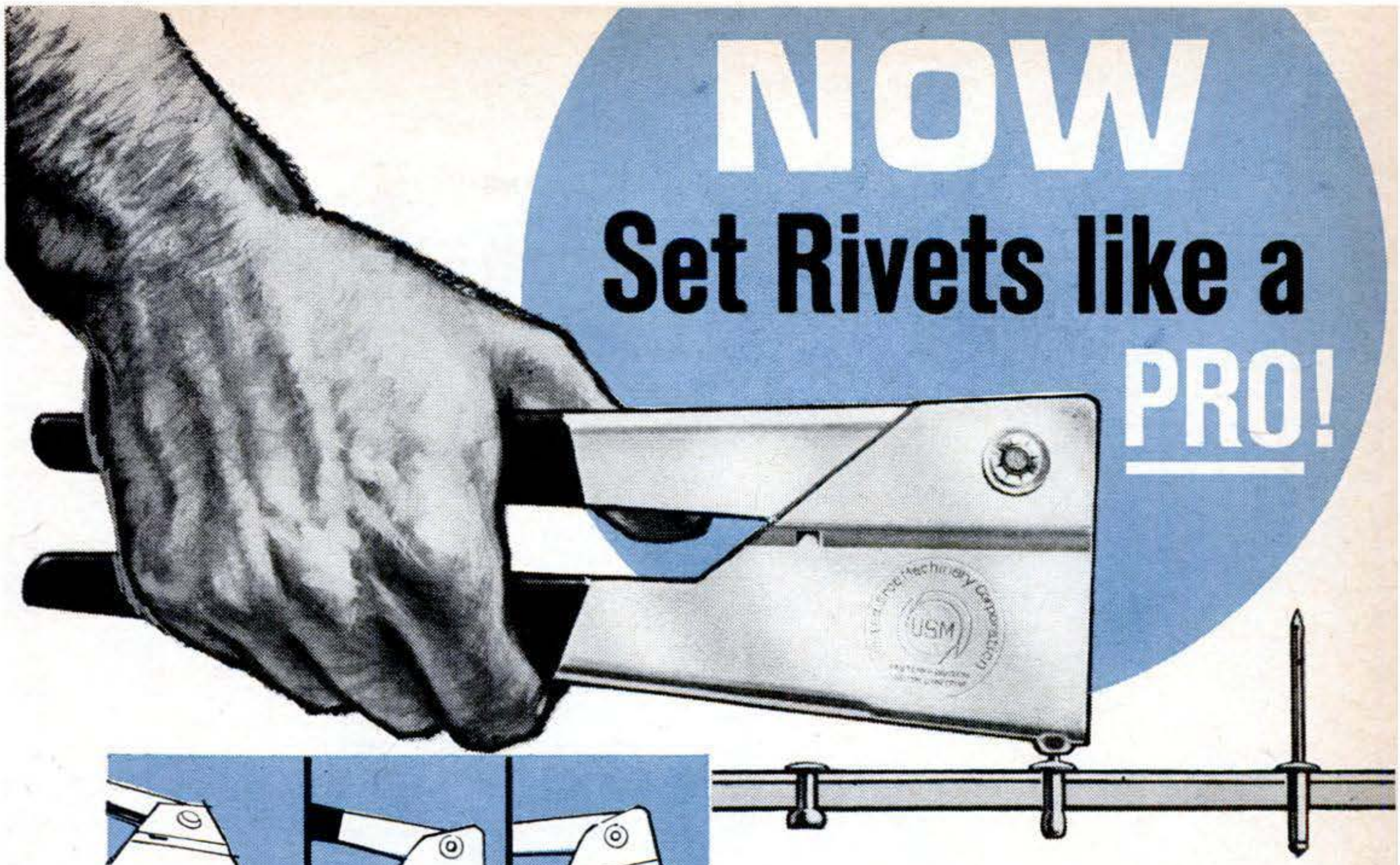

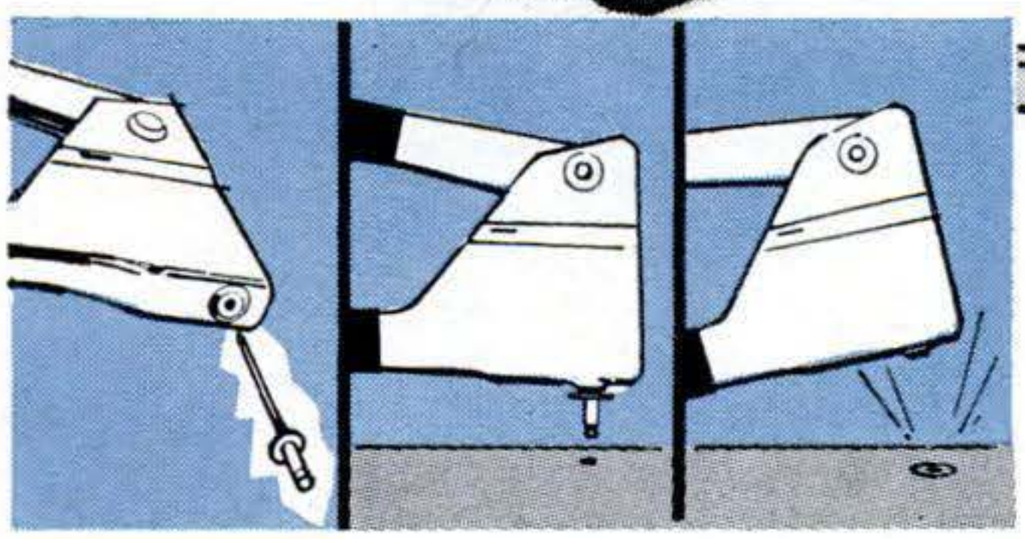

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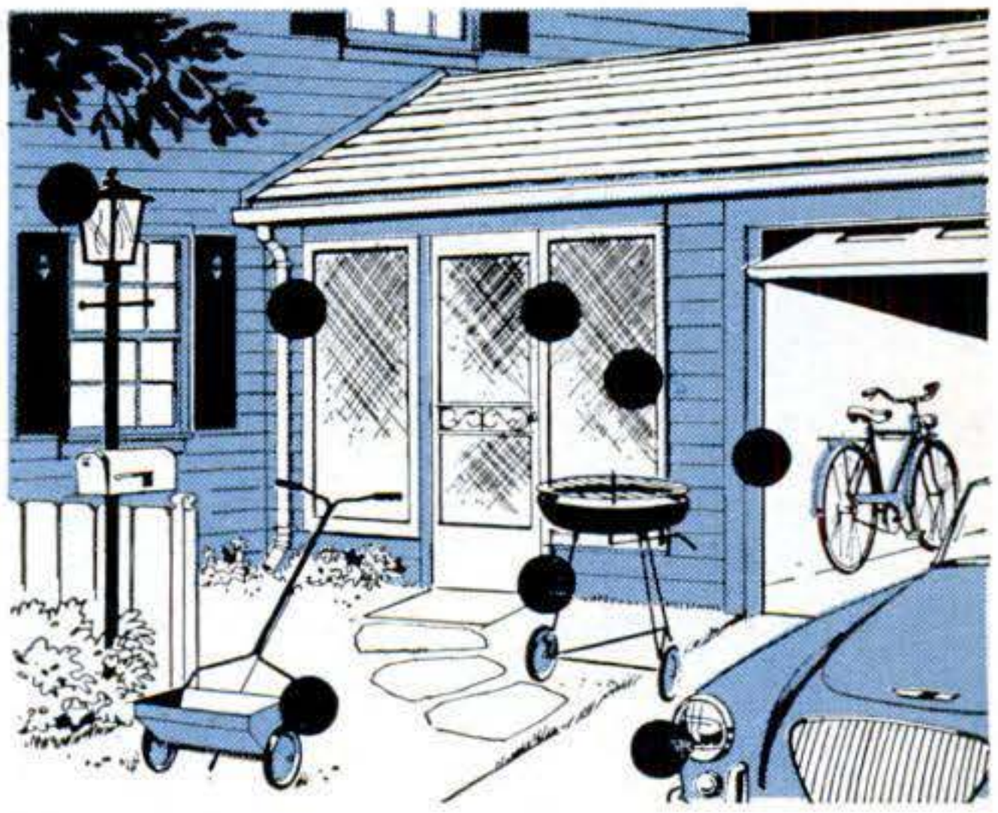

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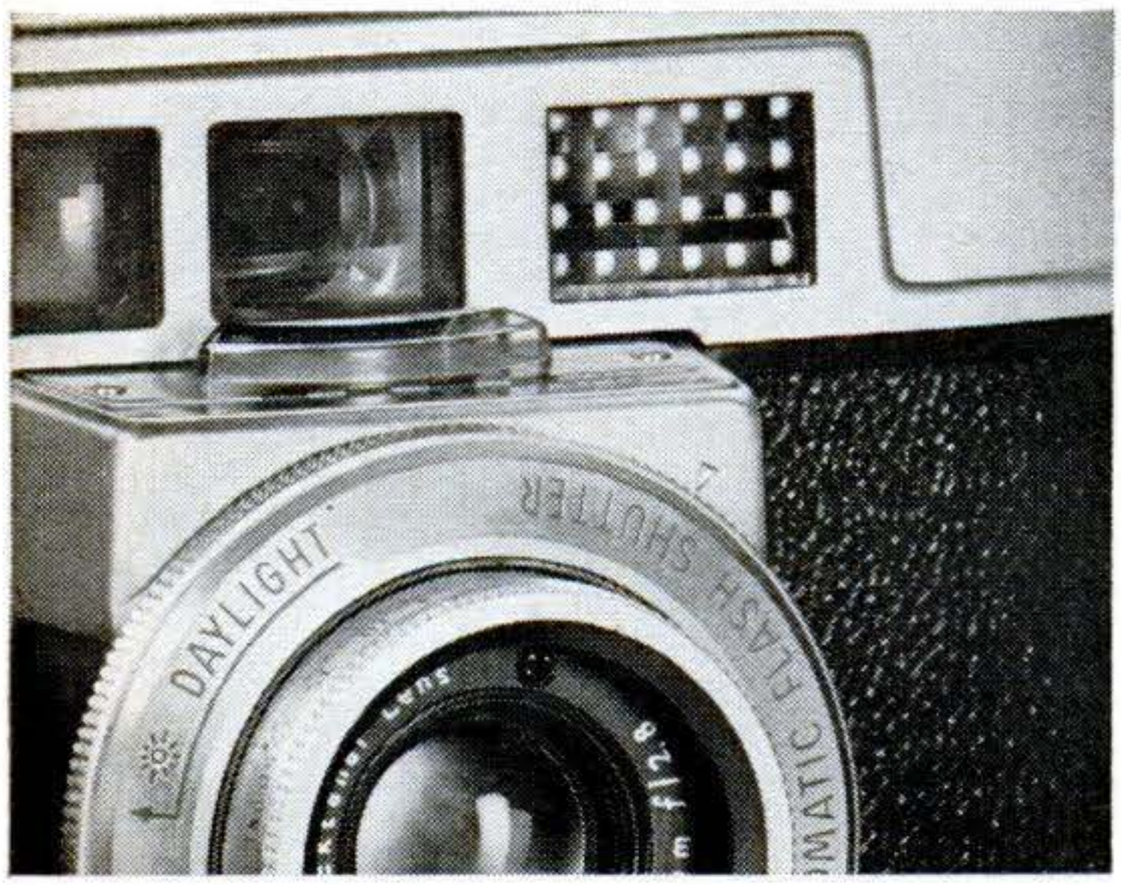

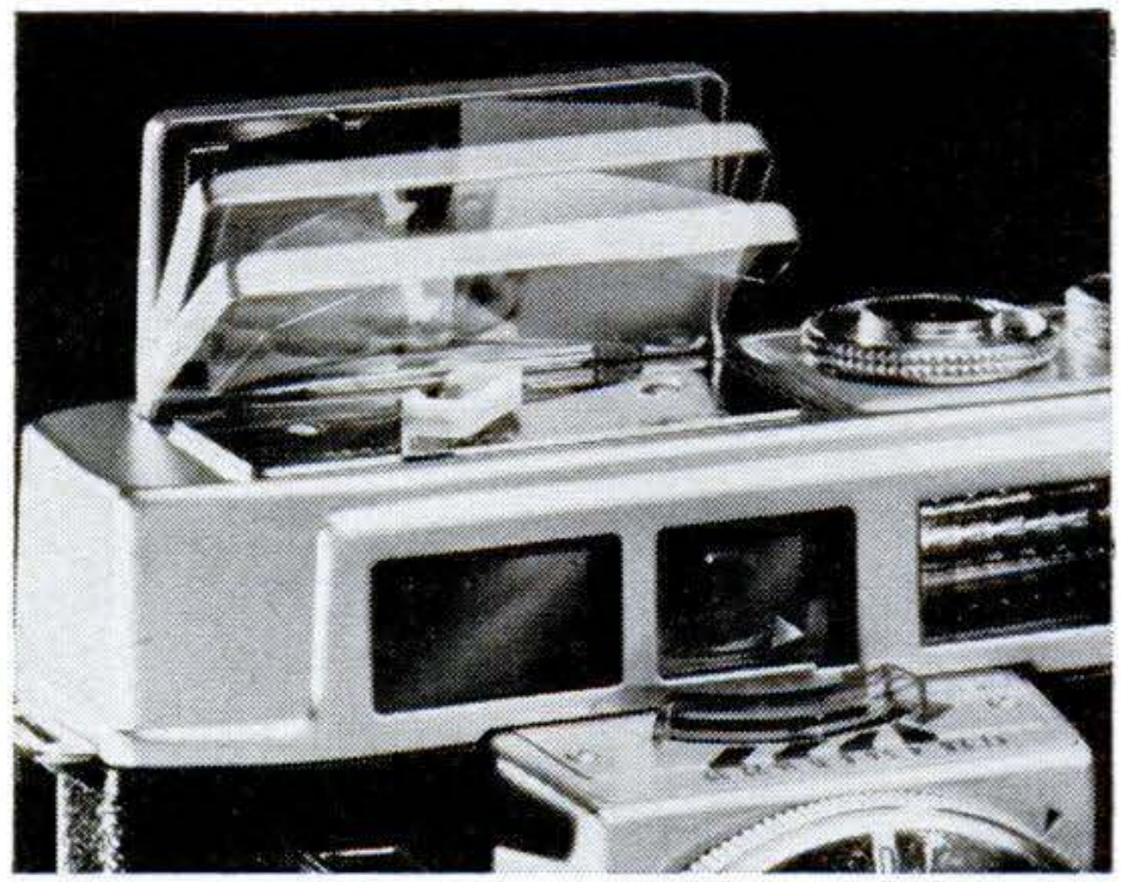

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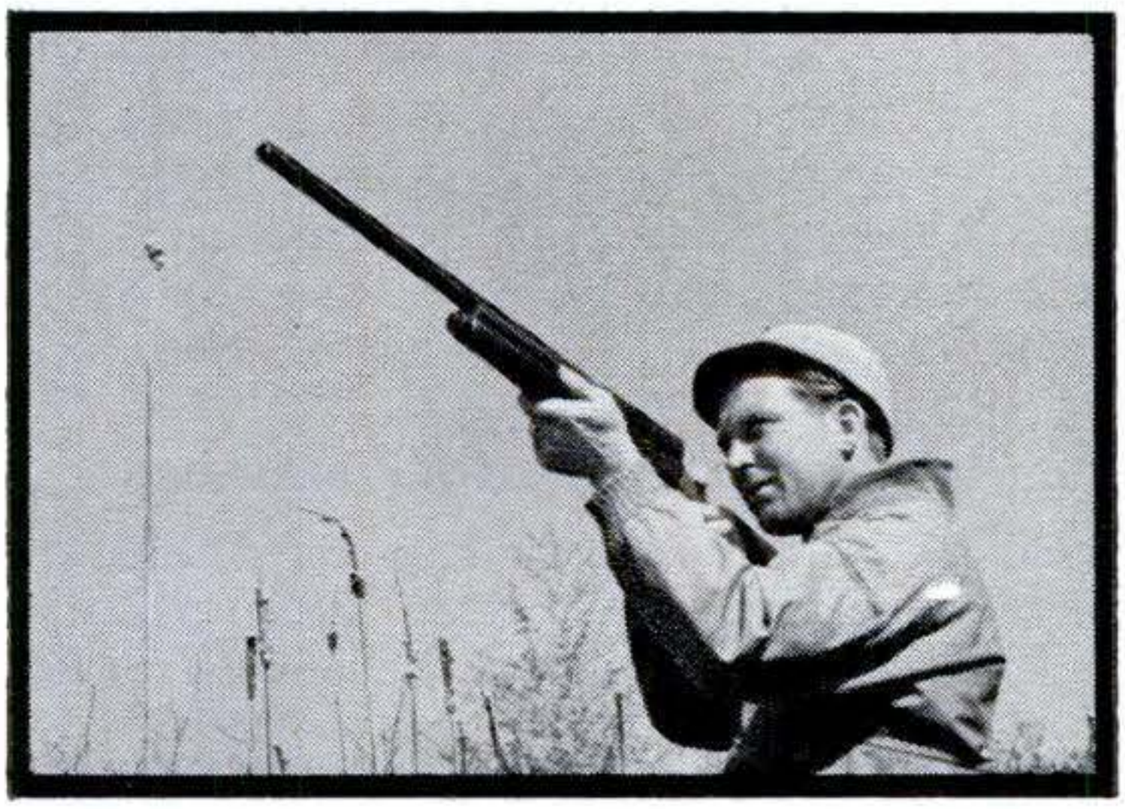

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What about exposure control? It's automatic . . . whether by daylight or flash. Shutter speeds to 1/250 let you freeze action.

For sharp shooting, a signal in the viewfinder tells if you're focused for *"close-up," "group,"* or *"scene."*

All the versatility you need for pictures any time, anywhere, is built into the KODAK MOTORMATIC 35F Camera. See it at your Kodak dealer's soon. With two high-energy batteries, neck strap, and special flashguard, less than $120. Give you an idea for Christmas?

Price subject to change without notice.

Kodak
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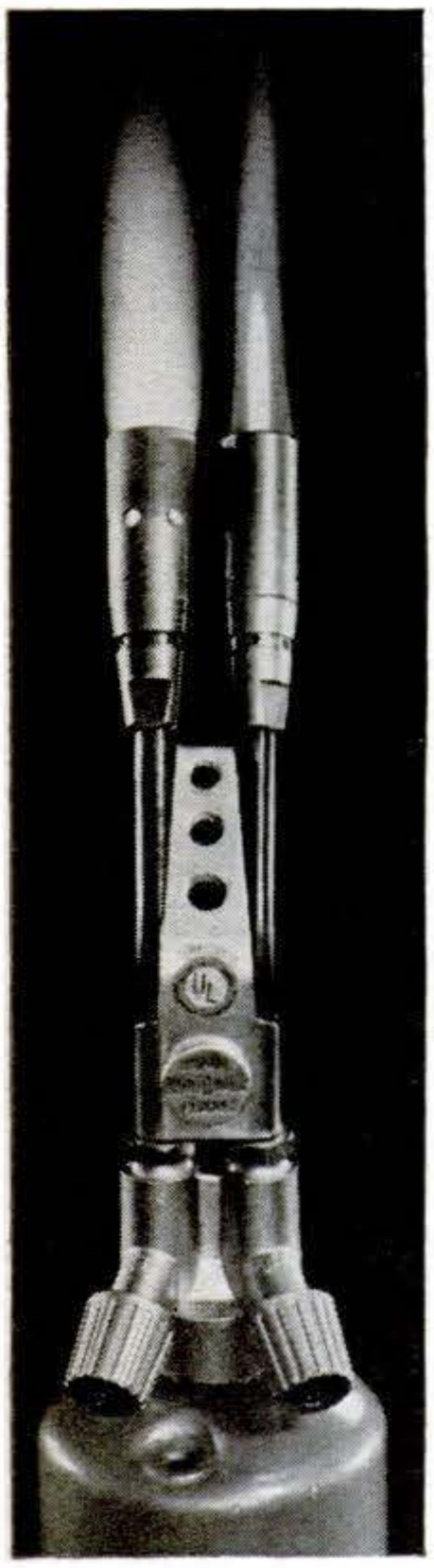
SHOP TALK By Sheldon M. Gallager

New gas torch: Two heads are better than one



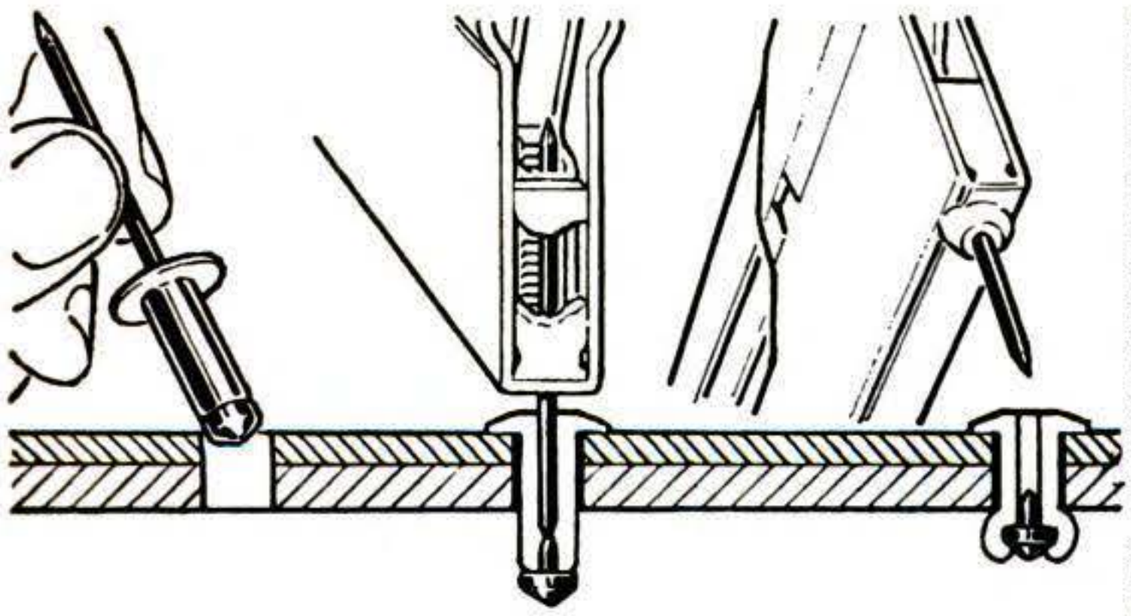
Just when you get to thinking that the handy little propane torch has gone about as far as it can go, along comes a new surprise. Now the BernzOmatic folks have brought out a dual-flame model with two burner tips side by side. Instead of having to switch tips, you simply use whichever one is best for the job—a fine, pencil-slim flame for delicate soldering or a broad, blowtorch-type flame for big-area work like removing paint or thawing pipes. Each flame is independently controlled by its own valve knob. Where you need extra-intense heat, you can even use both burners together. The twin-nozzle burner sells for $7.95, including a tank of fuel.

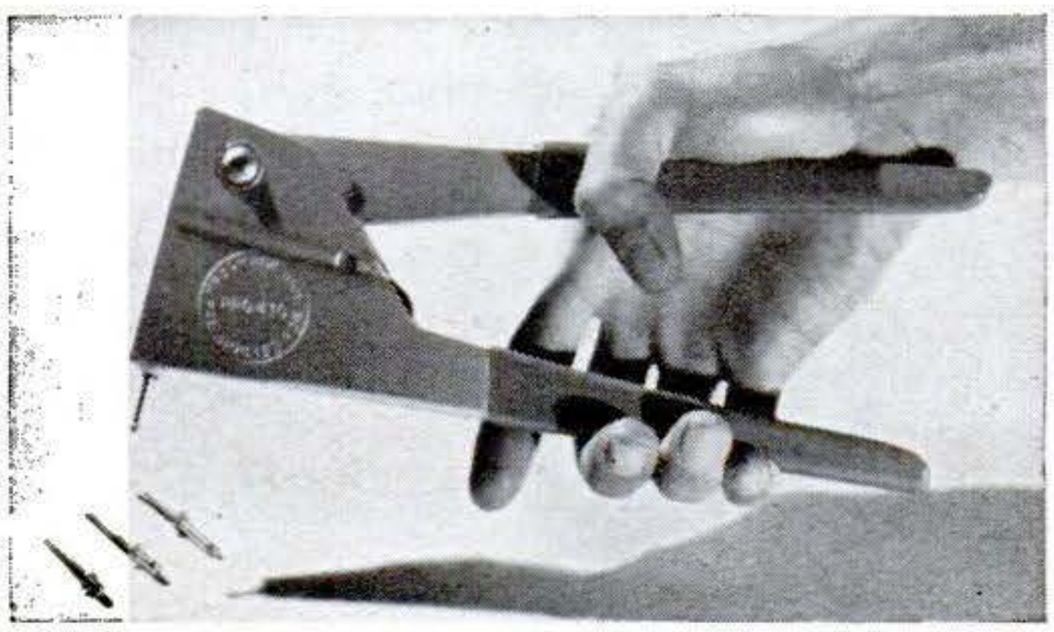
Quick and easy Pop rivets: Now they're back for home use

Remember "Pop" rivets—those ingenious fasteners that you clinch by squeezing a handle instead of hammering? They came out several years ago in an industrial version and made such a hit that they're now available in a small kit for home-shop use. For those who would like to use rivets more extensively but aren't sure of the proper technique, the Pop type makes the job a snap. It also works where conventional rivets and other fasteners can't be used easily.

The trick is that Pop rivets are inserted and clinched from the same side of the work. You just drill a hole, push in a rivet, and slip the clinching tool over a stem that sticks upward. As you squeeze the handle, the tool pulls the stem up through the rivet, flaring out the collar on the back side of the work, as shown below. As you continue squeezing, the stem breaks off, leaving the rivet clinched tightly in the hole. You can quickly install "blind" rivets in places where you can't reach behind the work.

The rivets come in three lengths—⅛", ¼", and ½"—for joining different thicknesses of materials from thin sheet metal and plastics up to plywood. On soft materials, a washer can be slipped under the flared end to form a flange and keep the rivet from tearing out. The kit, made by United Shoe Machinery, Shelton, Conn., includes the clinching tool and an assortment of rivets for $5.95. It looks from here like a fine new way to handle dozens of fastening jobs.





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The price is medium . . . the action maximum . . . the car is Mercury

The name is the tip-off . . . Marauder! This is an action car. Looks it. Acts it. A 390 cu. in. V-8 is standard. Optional engines range up to an 8-barrel, 427 cu. in. V-8 — the newest edition of the engine that now holds the stock-car record at Pikes Peak. Choose from six Marauder models–2-door hardtops or 4-door hardtops. Or, if you prefer, the same performance is available in Breezeway Mercurys (rear window opens for ventilation). See both at your Mercury dealer's. LINCOLN-MERCURY DIVISION Ford MOTOR COMPANY

'64 Mercury

No finer car in the medium-price field

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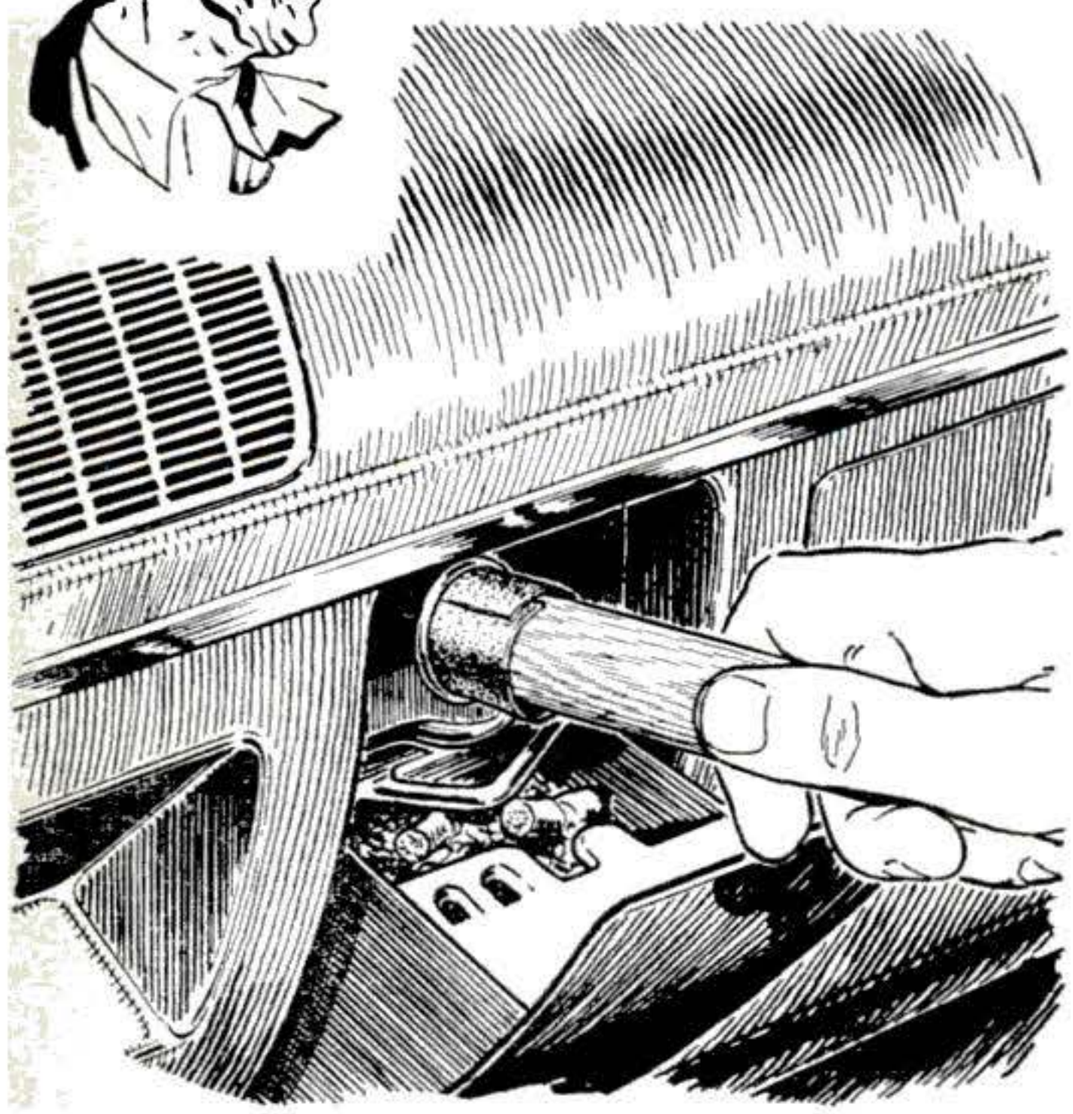
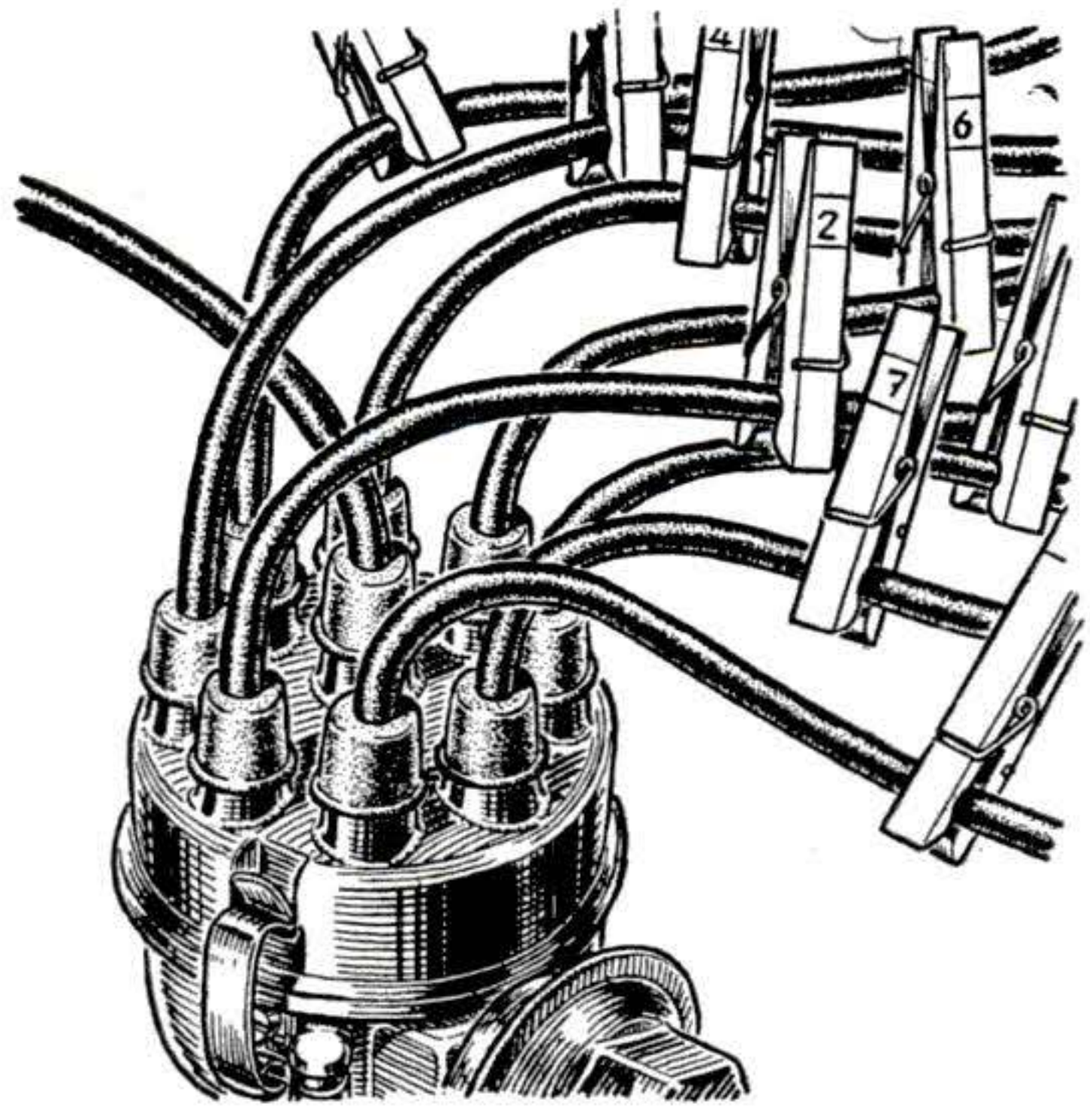
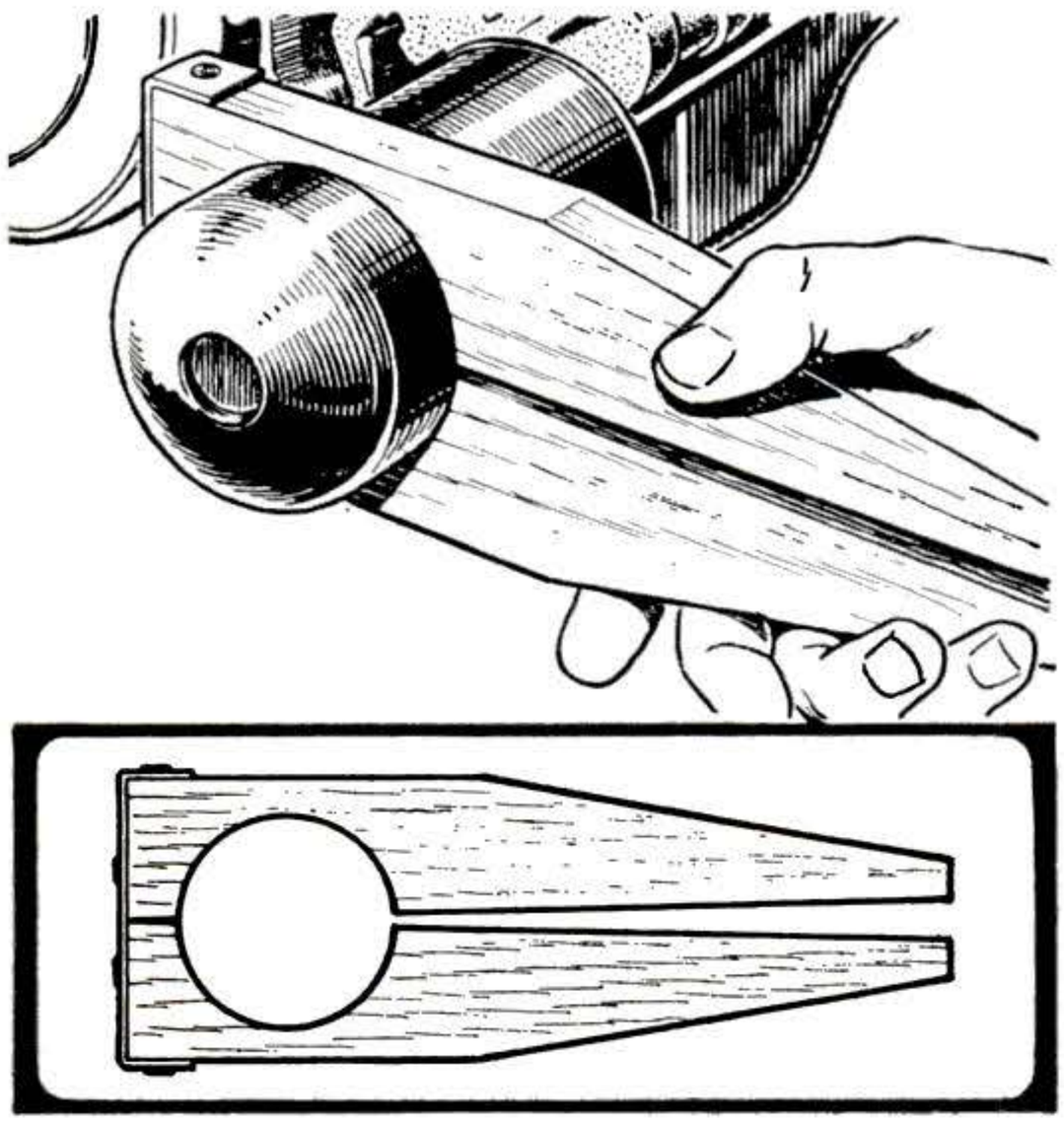
Hints from the Model Garage



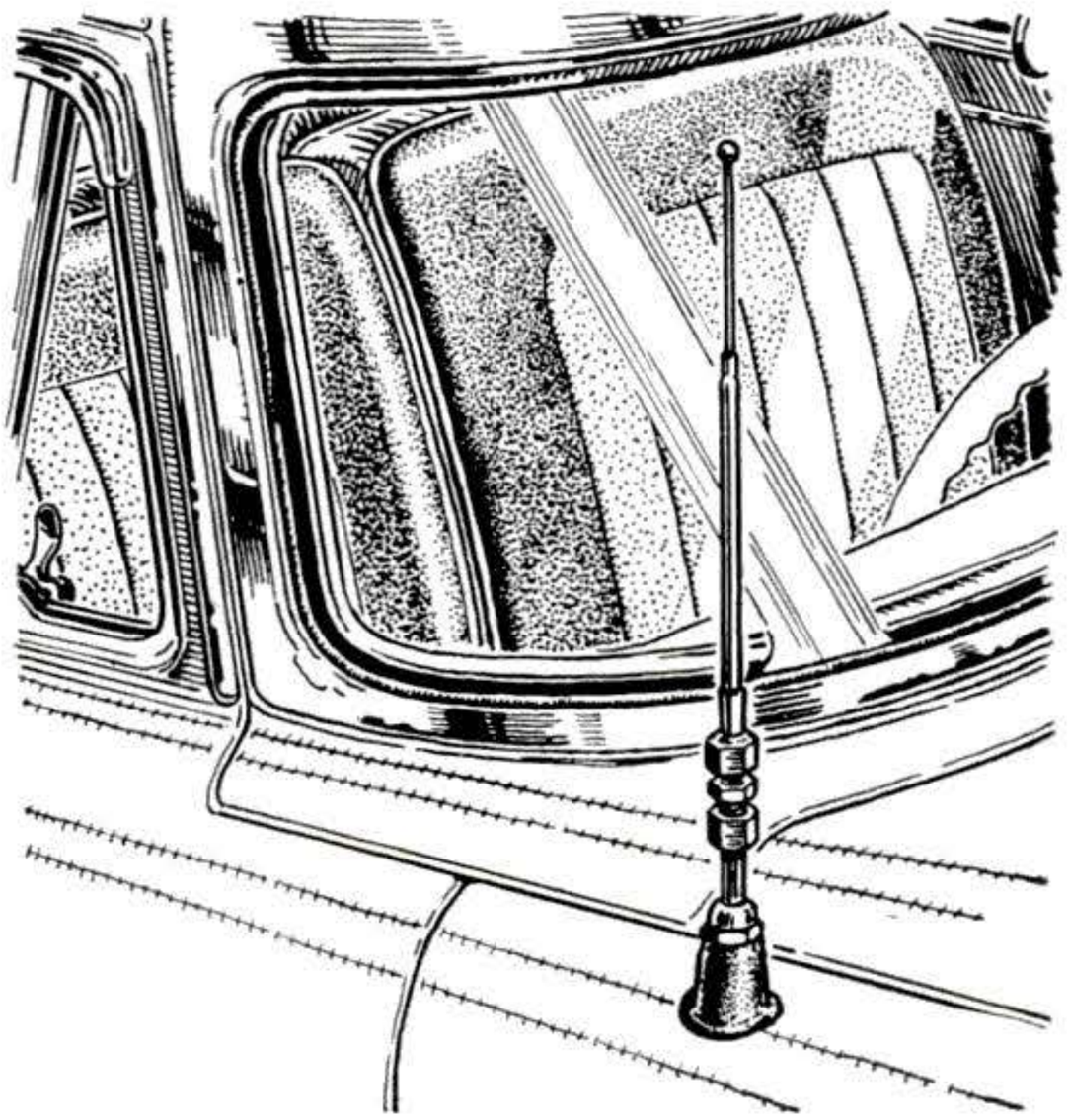
Cigarette-lighter problems often are caused by a poor ground between lighter and dash. To tighten the electrical connection, taper one end of a 6″ piece of broomstick, wrap in emery paper for a snug fit in the lighter casing, and twist the casing.



To keep from mixing up spark-plug leads, clip a numbered clothespin to each lead before removing it. Also, mark the number-one terminal on the distributor. With leads numbered according to firing order, it's an easy job to replace them properly.



Can't unscrew your oil filter by hand? Make a wrench from two pieces of ¾″ board, each 16″ by 2½″. Cut a hole between the two halves ⅛″ smaller than the diameter of the filter. Attach halves with four nails and a strip from a tin can.



A broken aerial needn't be replaced. Fix it with a compression coupling of the type used to join copper lines. You'll get a permanent repair without soldering or flaring the aerial ends. The ⅜″ connector is just right for most aerials.

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For instant starts all new Seagrave fire engines use silvery-plated Champions

Every major U.S. fire engine maker specifies Champion spark plugs because Champions have no equal for quick starting and dependability. Why settle for less in your car?

P.S. Here's the surest way to avoid starting trouble this winter. In testing thousands of cars last winter, worn spark plugs were the No. 1 cause of starting failures. In fact, cars with more than 10,000 miles on the plugs had three times more starting failures than cars with good plugs. So avoid a "no start" morning this winter. Install new Champions now!

DEPENDABLE
CHAMPION
SPARK PLUGS

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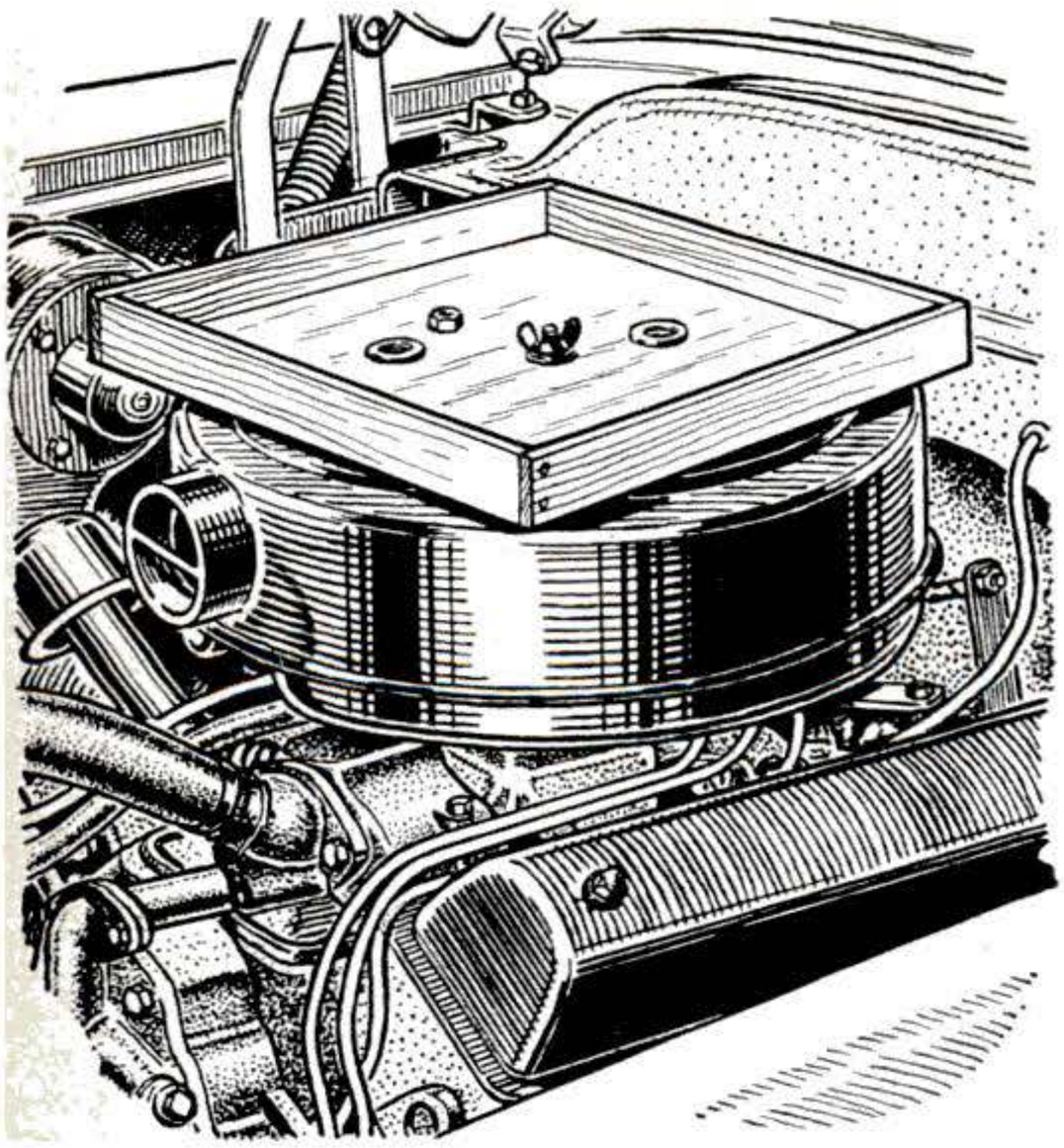
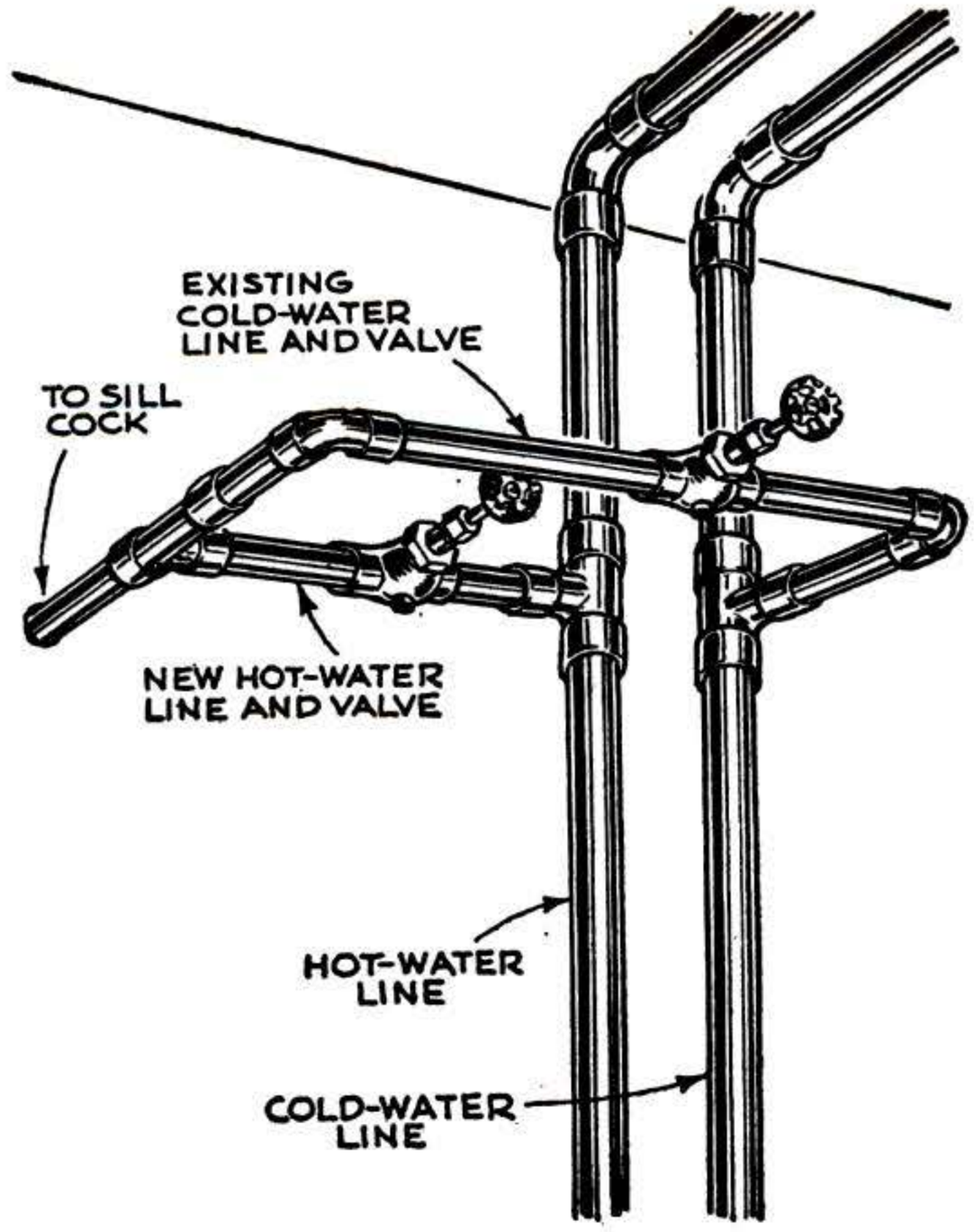
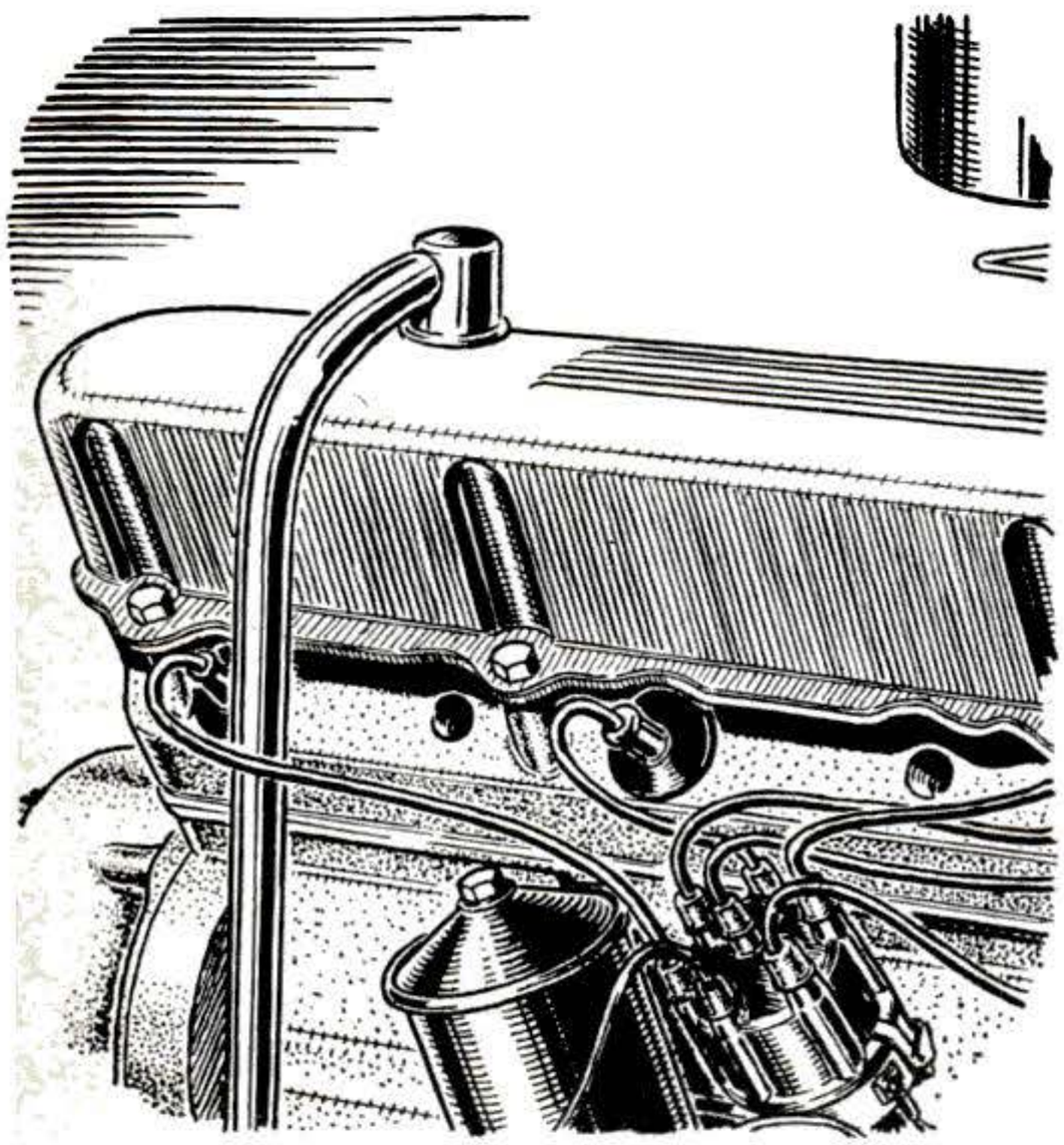
More Hints from the Model Garage



Keep tools and parts handy in a small tray made of wood scraps when you work under the hood. Drill a hole in the center to accept the air-cleaner bolt; fasten with the original wingnut. This works fine—except when the carb needs attention.



When washing your car in wintertime, the water can get numbingly cold if your garage has only a cold-water line. By connecting a hot-water line from the basement you can have warm water. A shutoff valve lets you turn off hot water in the summer.



An engine that wouldn't crank fast enough to start because of cold—this was one reader's problem. He removed every other spark plug to gain cranking speed. The engine started, soon warmed up. He shut it off, replaced the plugs, restarted easily.

If you've mislaid your ice scraper, an ice-covered windshield isn't the most pleasant sight to see first thing in the morning. Look around the house for a spare electric-outlet cover; it makes an effective and nonscratching substitute.

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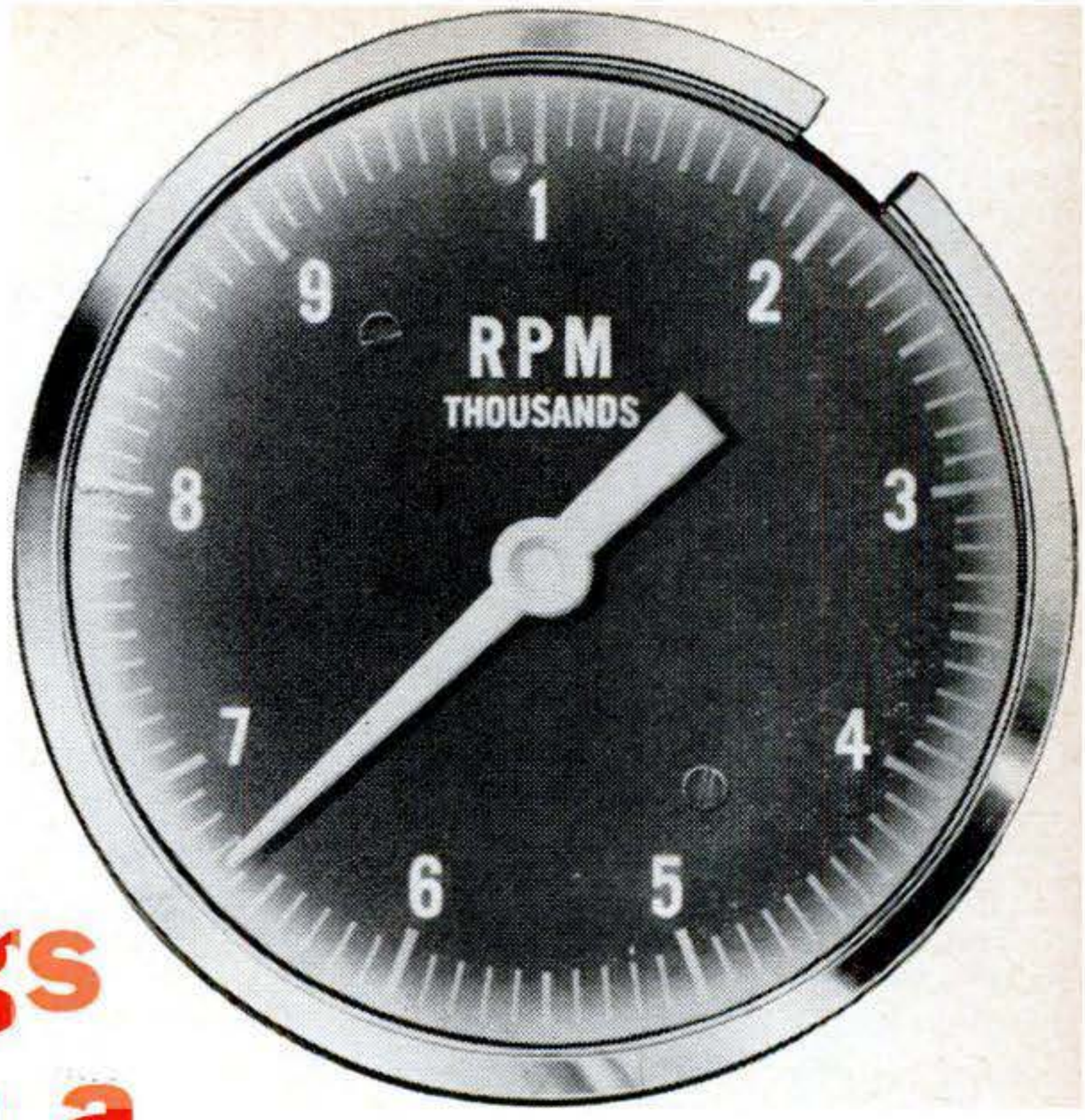


PC rings travel with a *fast crowd!*

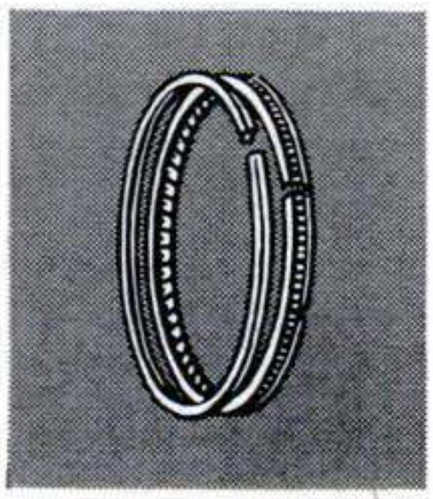
Why racing "pros" prefer Perfect Circle rings—the piston rings to install for championship performance in any engine

The flag says "GO!"—and race drivers show no mercy for the engines at their command. Winning depends on skill and a car that's got guts. Engine parts can make the difference. That's why racing "pros" throughout the country prefer track-proven Perfect Circle piston rings.

Since 1922, cars equipped with Perfect Circle rings have won more than 80% of the races at Indianapolis. Year after year, more major USAC and NASCAR competitions are won by drivers using PC rings than any other piston ring brand.

Are these rings "race specials"? Not at all. They're just like the high-quality Perfect Circles you can install, or have installed, in your car. There's no difference in design, material or manufacture. They give the same precision fit and long-life dependability for championship performance wherever they're used.

Every PC ring job should include Perfect Circle Valve Seals, too. They positively stop oil loss through valve guides, effectively cut oil costs, improve engine efficiency, and stop port coking.



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Gus Warms Up a Cold Customer

By Martin Bunn

GRATEFULLY Gus swung his wrecker into the alley behind the Model Garage and parked. He stepped from the heated cab, his breath fogging in the chill November air. Snow changing to ice the night before, with temperatures to match, had brought a rash of emergency calls all morning.

The big Chrysler parked near the pumps, could be one more. If so, it could wait until he'd warmed up over coffee and a pipe, Gus thought. But if it had gotten this far, why hadn't Stan put it into the shop?

A swirl of arctic air almost blew Gus through the back door when he unlatched it. Forcing it shut, he felt the cozy warmth created by the shop blowers. He saw nobody in the office or out on the shop floor.

"Ov-ve-ver here, G-G-Gus," called Stan.

Gus's helper was huddled under the largest blower in the shop, teeth chattering and ears beet-red with cold.

"What happened to you?" asked Gus.

The eyes Stan turned on him were as woebegone as a scolded spaniel's. "That road locomotive out front, Boss. Oscar Nielsen's car."

Nielsen was an occasional, and usually difficult, customer. While admitting that he knew little about cars, he had definite ideas about what he wanted done any time he brought his in.

"I'll start coffee, Stan. Come tell me about it when you're ready," said Gus.

Gus switched on the percolator and a radiant heater. He was glad to find no more road calls on the pad in the office. As he readied two cups, Stan trudged in.

"Get outside this," said Gus, shoving a cup of steaming java in front of his helper. "Where did you manage to get so chilled?"

Stan drank as if inhaling warmth. "Out front, Gus. That's where that stubborn Swede said I'd have to find the same short he didn't have last year."

"Seems it kept well," grunted Gus. "Back last March, I remember, Nielsen wanted you to find out why his circuit breaker kept clicking on cold mornings."

"Only, he thought it was the ammeter! Well, I couldn't hear it click, or find any short. So he forgot it all during the good weather. Today, in the worst cold snap we've had yet, he shows up with the same beef and has to have it fixed. He parked out there and wouldn't drive it in; said I'd have to hunt the short in the cold this time, because that's where it happens every time."

Gus nodded thoughtfully. Nielsen, the best carpenter in town, was a mule once he'd made up his mind. "He just could be right, at that."

"Yeah? I've been all over the wiring, switches, and accessories. Not a thing wrong any place. My fingers got so stiff I had to quit a couple of minutes before you showed up. Maybe he'll forget about it for another year."

Leaning back, Gus slowly packed his pipe. "*Something* happens, Stan, or Nielsen wouldn't have come here. How did he say the car acted this morning?"

Stan shrugged. "Same as last year. He has no garage and parked in the back yard last night. This morning he came out to start the engine—he always warms it up while he eats breakfast, he says.

"It started okay, but then he noticed the ammeter needle going crazy. From normal charge it would suddenly snap to full discharge with a loud click, go back to charge, then do it all again."

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Bundled up for warmth, Gus checked everything from dipstick to stoplight wiring.

"Did you ask what accessories he had turned on?" inquired Gus.

"Sure, and he asked me what kind of fool I took him for. At night he just switches off the ignition, becauses he knows that kills the accessory circuits. But mornings, before he even puts the key in, he says, he first switches off the heater, electric wipers, and radio so the battery can put all it's got into cranking."

Gus dragged on his pipe. "Sounds like what Nielsen would do. I'll buy that."

"Un-huh. Well, the windshield was all iced up this morning and he had to get to work, so he switched on the defroster and let the engine run, still clicking. When he came out after breakfast, the ammeter was behaving and the clicking was gone. I let the engine get stone cold again before I checked it, like he told me to. But no clicking, no short—just frostbite."

Gus nodded. "I've got a hunch you just told me why it happens, though I don't see it yet. Make you a deal, Stan—I'll double-check with a meter and take care of Nielsen. You take the next customer or road call, whichever it is."

"Boss, that's no deal—it's a favor."

The next customer drove in with a com-

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plaint of hard starting, and Stan sold him a badly needed set of new plugs. Gus bundled himself up again and went out to Nielsen's car. The first thing he did was look at the oil on the dipstick.

Then, with the ignition on and a multimeter connected, he checked everything from the stoplight wiring to the radio switch. Every accessory checked with known values. There was no sign of leakage to ground, let alone a short. Almost as chilled as Stan had been, Gus finally went back inside.

Could Nielsen's habit of switching off only the key, instead of individual accessories, be the tip-off? But these did draw power through the ignition switch—Gus had checked that, just in case somebody had rewired things. With the key out, all auxiliary circuits were indeed dead. Besides, it was with the engine running that the discharge occurred.

Two more road calls took Gus out of the shop. One was a tow job that brought him back with a sports car dangling from the hook. Shortly after, with dusk darkening the sky, the summons of a horn outside made Stan open the main shop door.

A big Pontiac rolled in, its windshield almost opaque with frozen slush. Only through the window could Stan see the driver. He was a stranger. But the passenger who emerged was Oscar Nielsen, his lanky six-feet-two crouching to avoid hitting the door frame. Gus came forward as the carpenter set down an enormous tool case and glanced at Stan.

"Ay got a feeling you didn't find the trouble with my car."

"We didn't find any short," said Gus.

The carpenter snorted, his shrewd blue eyes now on Gus. "You are an expert, Gus Wilson, so ay believe you. But some kind of trouble my car has got, for sure."

He turned to indicate the other man.

"My friend Mike Moran drove me—ay be glad not to walk after a long day working. He has trouble, too. Maybe you can fix his better than mine?"

"We'll sure try," said Gus. "And we haven't given up on yours. Maybe Stan can help you, Mr. Moran. What's wrong?"

The stubby little man jerked a thumb at the windshield. "See the muck on that? Think I drive like that because I enjoy it? It's like this: whenever I use the windshield washer, my engine bucks like it's about to give up the ghost. Watch!"

Hopping into the car, Moran started up the engine. Then, as twin jets of water sprayed the dirty windshield, the engine's smooth idle broke into a ragged, bucking gallop.

"You see? Didn't need it this morning, once I cleaned off the ice. But all day the car wheels have been throwin' up dirty slush, and it would sure be a help—"

"Stan can fix that in a jiffy," said Gus, grinning. He'd just been presented with a missing clue. "Mr. Nielsen, you're sure that you always turn off everything before you start the engine in the morning?"

"Sure. Ay want to save the battery in cold weather."

"Let's go to your car," suggested Gus.

Gus started the engine of the Chrysler, turned on the heater, headlights, and wipers, and got out.

"You get in," he said to Nielsen. "Imagine you've just arrived at home. Do exactly what you always do."

Nielsen killed the engine. The hum of the heater died. Wiper blades halted in mid-arc. The headlights faded out.

"Now," ordered Gus, "pretend it's morn-

"They didn't give me the rear-axle ratio I ordered in my new car," said Jones. "And I mean to prove it. Can you come over with your jack and help? We'll raise both wheels. I'll turn one and my boy the other, while you count drive-shaft revolutions."

"Probably won't be accurate," objected Smith. "Too hard to keep the two wheels precisely synchronized."

"Must I take the rear axle apart and count teeth?"

"No, I'll come and show you the easy way," promised Smith. "We won't even need the extra jack."

...How Come?

ANSWER: Smith told Jones to jack up one rear wheel, then turn it 20 times while counting drive-shaft revs. With the other wheel motionless on the ground, the differential gears caused this wheel to make two turns to the ring gear's one.

As 20 revolutions of the wheel made the drive shaft revolve 43 times, Jones had only to divide this figure by 10 (i.e., insert a decimal point) to find that the rear-axle ratio was 4.3:1.

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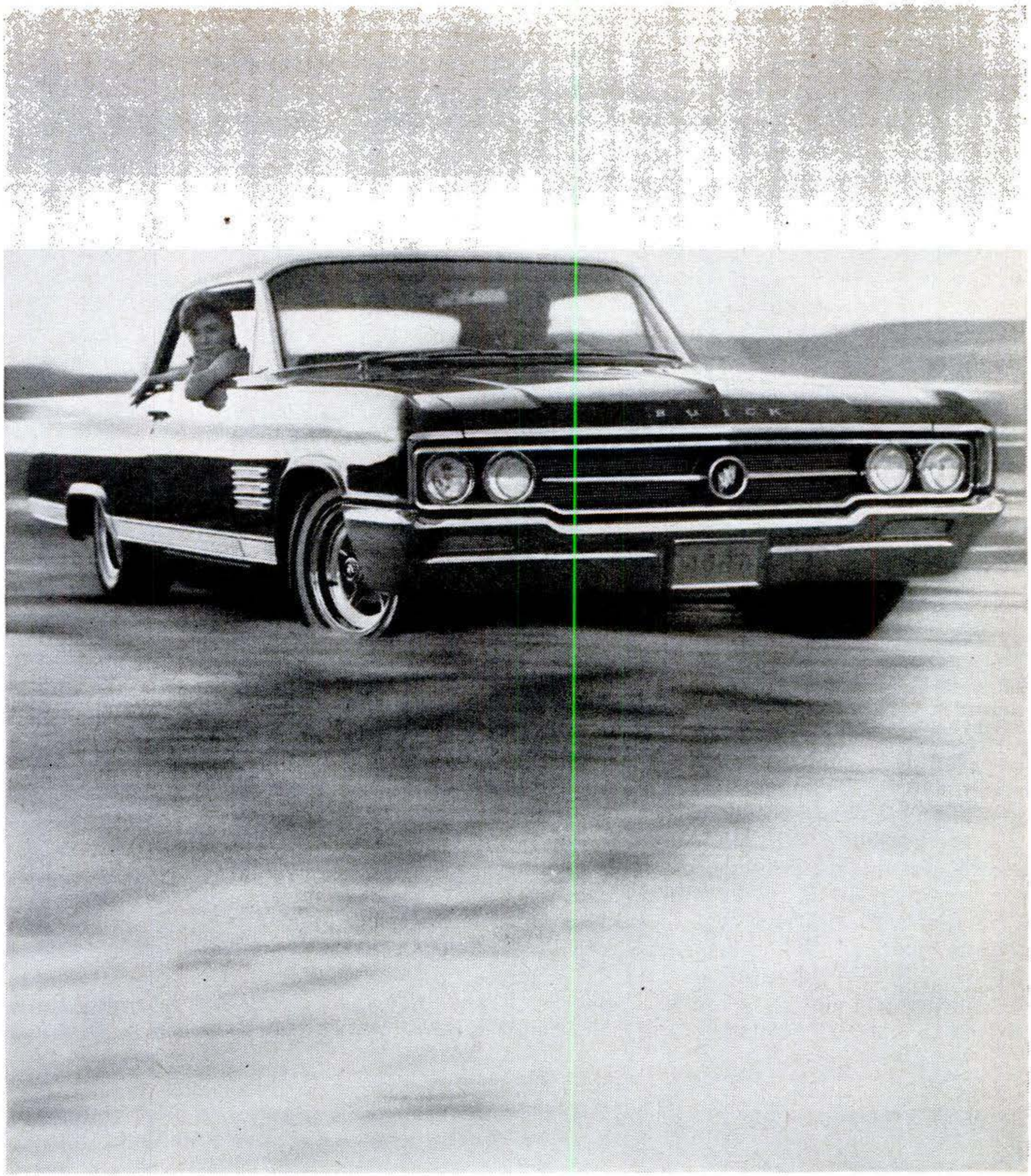

Buick Motor Division

Everybody out of the rut . . . the '64 Buicks are here!

Our happiest problem for '64 was: how to beat a winner? According to thousands of owners, the 1963 models just about had it made in all departments. But—when your name is *Buick*—you just don't rest on your laurels. You keep pushing to make a great car greater. So . . . the '64 Buicks are new—but *new.* New engines, V-6 or V-8 (you'll like their new gas economy), new, smoother, extra-cost option, Super Turbine Transmissions (and who, but Buick, would build in an altitude compensator?). Youngest looking Fisher Bodies in town! Visit a showroom, sit in any one of the new Buicks, and practice this short easy line: "My Buick." Sounds good, doesn't it?

...above all, they're BUICKS!

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ing and you want to warm up the engine."

"But now is not the same," protested Nielsen. "Now it is warmed already."

"I'll allow for that." Gus watched as Nielsen shut off heater and wiper switches. As he turned the ignition key, Gus seized the nearer wiper. It surged in his fingers. He held it firm. Nielsen, intent on the ammeter, didn't notice.

In about 10 seconds there was a loud click, and very soon another. Gus released the blade, and both slid to their off position and stopped.

"You heard it?" asked Nielsen.

"I did. I was causing an overload by holding one wiper," returned Gus. "The motor was trying to move it, and drew so much current your circuit breaker snapped open."

"How could this be?" demanded Nielsen. "You saw me—ay turned off the wipers."

"That's right, but there's a bypass circuit that powers the motor until the blades are back in their off position in a corner of the windshield. Soon as you turned on the ignition, that circuit was closed."

"Ay was not holding any wiper blade this morning!" declared Nielsen.

Gus chuckled. "No—it was frozen tight, where it stopped last night. Once the defroster thawed them, both blades swept back and the motor shut off, ending the overload. But this morning you didn't have to use the wipers at all. The condition Stan was hunting wasn't there."

Nielsen nodded. "It was all my own doing. Ay will turn things off at night."

"If you don't mind some advice," said Gus, "your engine would crank easier and your battery stand up better in this cold if you'd change your oil. Use a multiviscosity oil instead of the heavy one that's in now. And I'd skip the long warmup. Engineers now agree that a car shouldn't be idled long on cold mornings, but simply driven off at reasonable speed. Just be sure your thermostat opens at the right temperature for the antifreeze you're using."

"Good advice I'm glad to take." Nielsen's blue eyes crinkled. "It will anyway give me five minutes extra for breakfast."

Warm and cozy in front of the heater, Stan winked at Gus as he came in. "Sure outfoxed you when I got that easy job and let you rassle with Nielsen."

"Turned out there was nothing to do on his car." Briefly Gus explained.

"Moran's job wasn't that tricky," insisted Stan. "I couldn't find any vacuum leak, so I twisted around the washer tubing to see if it was okay. When Moran punched the button, the answer hit me smack in the eye—a squirt from near the T-connection middle of the cowl."

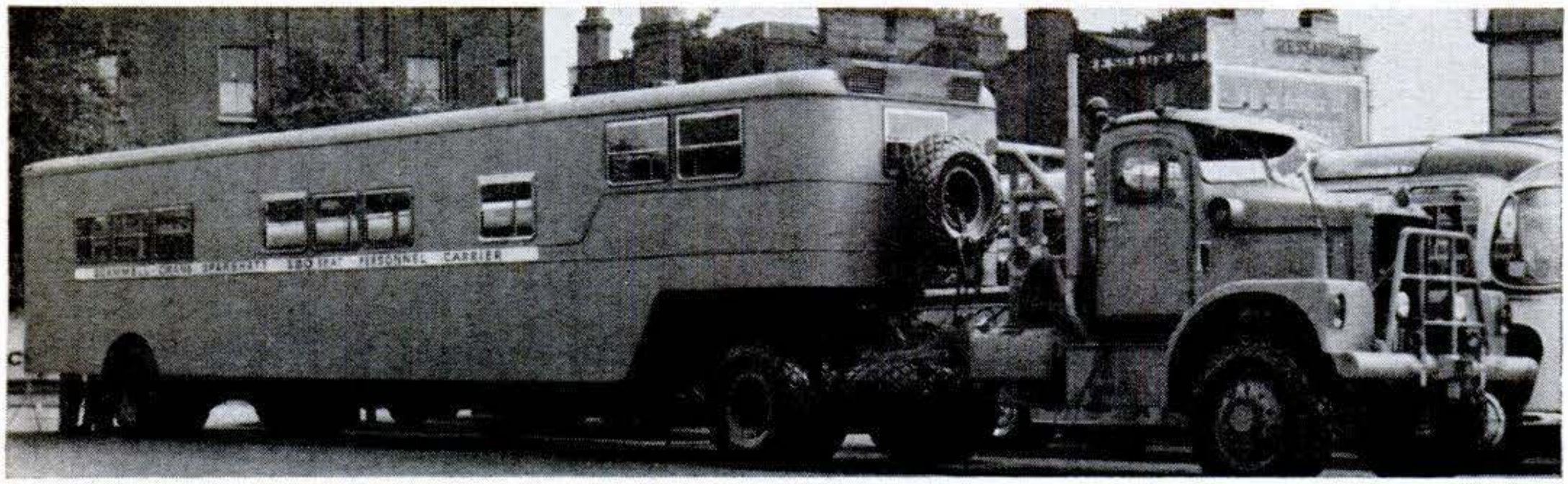
"That's using your head," said Gus.

Stan flashed him a suspicious glance. "I let go the tubing to wipe my face, and it aimed that squirt right at the distributor. Soaked the wire to number-six plug, so that cylinder cut out. All I had to do was cut the tubing back to the pinhole."

"You're right then. My job *was* tougher than that. Much tougher."

"What'd you do that you haven't told me?"

"What sometimes seems the hardest job in the world," replied Gus. "Think!" ■ ■



Single-decker bus is a whopper

This commuter's dream—a 120-seat bus—will carry engineers across continents, or oil-field workers across deserts. The British semitrailer stretches 48 feet and is 9½ feet wide with 7-foot head room. It has an insulated double skin and is air-conditioned. A tractor with a 150-hp. Rolls-Royce diesel driving both axles pulls it.

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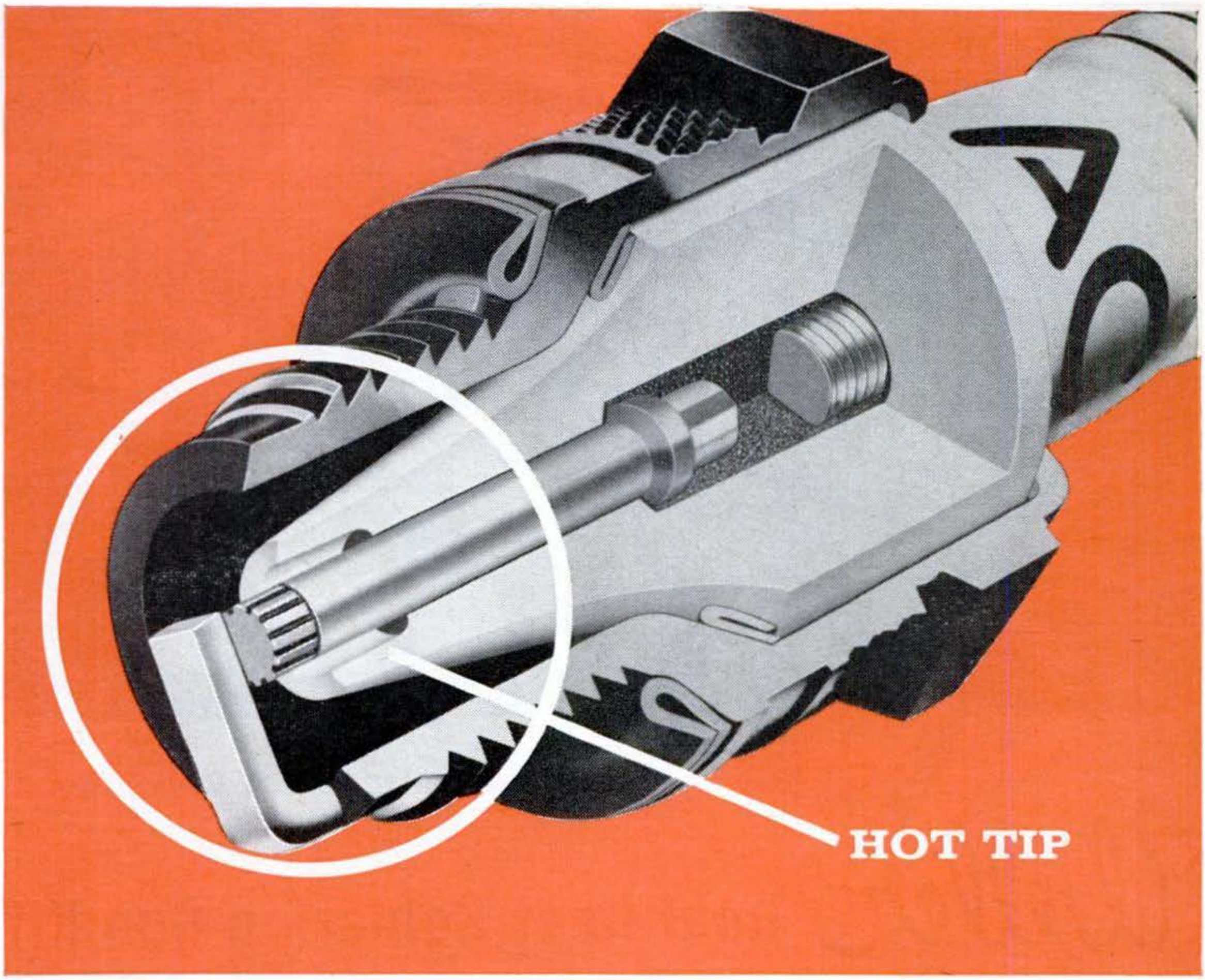
AC Spark Plug Tip Design helps you boost power, boost mileage



Where other spark plug insulators hug the center electrode all the way to the tip, the AC insulator is recessed, at the end. This deeply recessed insulator tip heats faster, cools faster, to promote AC's exclusive self-cleaning action. The thinner tip leaves more space around the insulator for better scrubbing action by swirling hot combustion gases. Result: less fouling, better sparking that helps you get more power, more mileage. Look for the recessed tip when buying spark plugs for your car. Only AC has this Hot Tip—so insist on AC Fire-Ring Spark Plugs when you buy.

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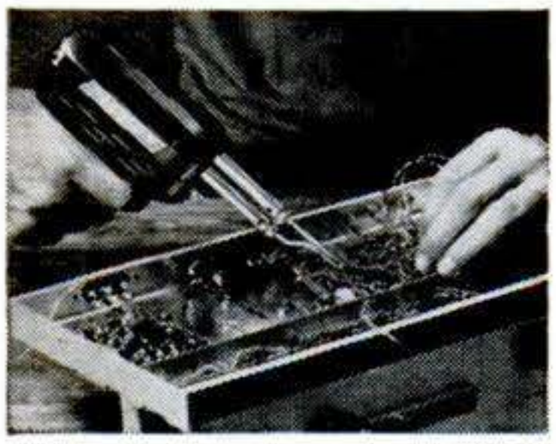
A gift any man will want and use.
Especially you!

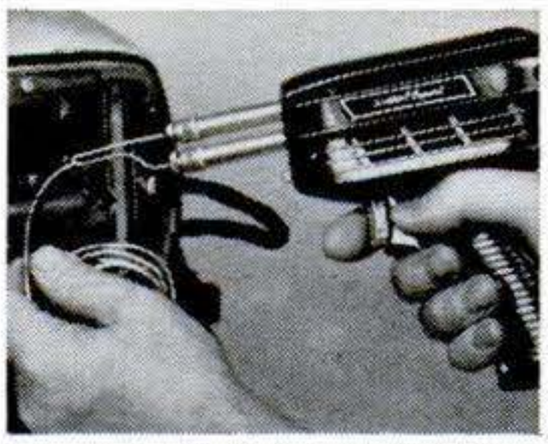
Weller® Dual Heat Soldering Gun Kit

Everything that's needed for quick, easy soldering and scores of household repairs. Features the same Weller "Expert" Dual Heat Gun that's used by professional servicemen and homecrafters the world over. Pull the trigger—tip heats instantly and spotlight illuminates work. Two trigger positions give a choice of two soldering temperatures. You can switch instantly to high 140-watt or low 100-watt heat to suit the job. By using high heat only when necessary you prolong tip life. Tip is made of copper for superior heat transfer and premium plated for rigidity and long life. Included: 3 soldering tips, tip-changing wrench, flux brush, soldering aid, solder. And everything is in a colorful, break-proof plastic carrying case. Model 8200PK. Weller Electric Corp., Easton, Pa. **$8.95** list

For hi-fi kit building

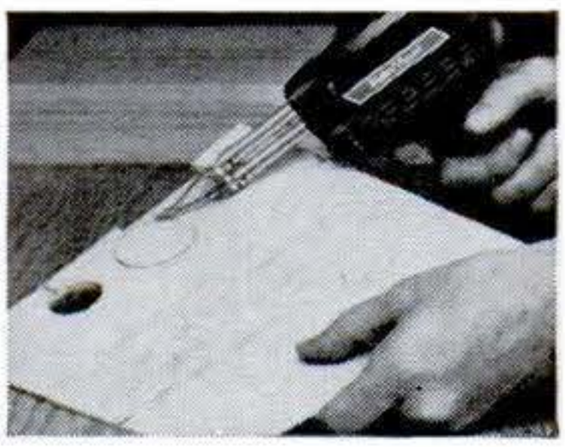


For electrical repairs



For mending metal

For many other jobs



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The Popular Science Buyer's Guide to Home Shop Tools PART 1

10 basic STATIONARY power tools

- TABLE SAW
- RADIAL-ARM SAW
- DRILL PRESS
- POWER SANDERS
- JIGSAW
- BANDSAW
- WOOD LATHE
- METAL LATHE
- JOINTER-PLANER
- SHAPER

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NOW MATCH WOOD TONES LIKE A PROFESSIONAL

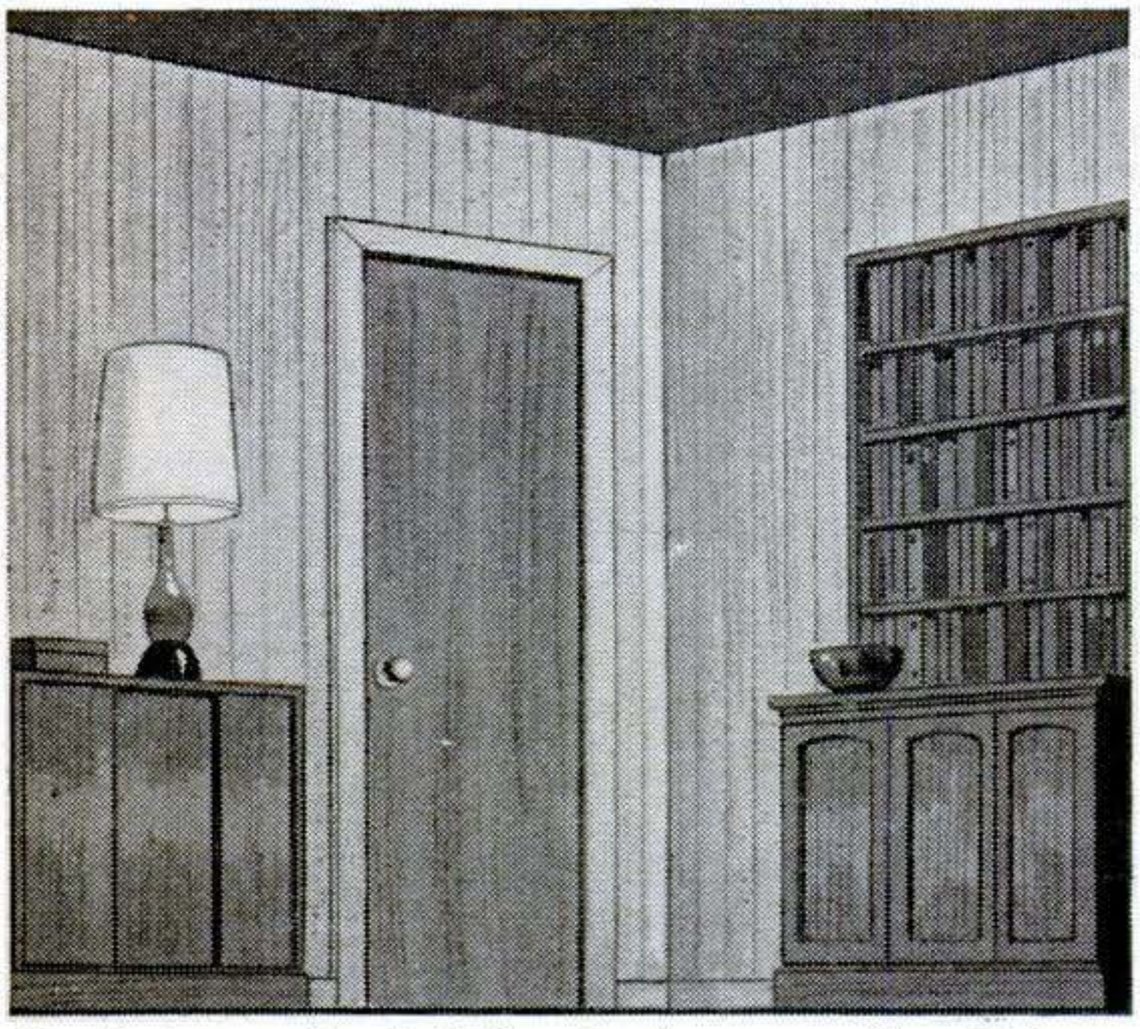

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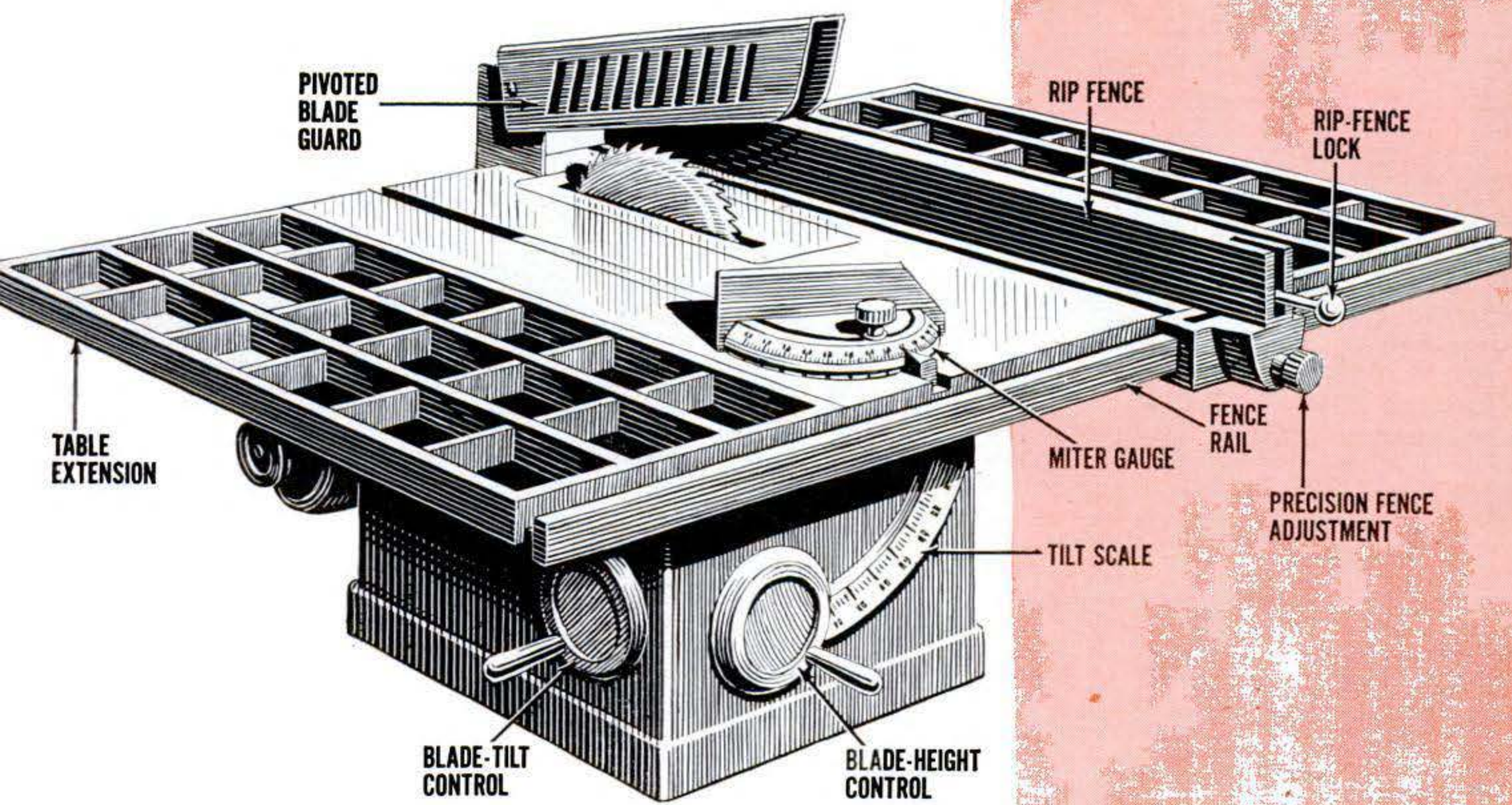
TABLE SAW

the basic tool for cutting wood



ASK any pro about his first power-tool purchase, and 99 times out of 100 you'll get the identical answer: a table saw. This is the real workhorse in any shop. It's not only *the* tool for making precision cuts in wood, but it can do many added jobs as well.

An important point to note is that the old tilting-table saw is now practically extinct. Nearly all modern saws tilt on the arbor while your work stays flat on the table—a great convenience.

The first decision to make on a table saw is blade size. This varies from 7″ to 12″. Naturally, the bigger the blade, the thicker the wood you can cut. But there's a sleeper here to watch for. A blade loses a lot of cutting depth when you tilt it; what it will do on straight cuts is not at all what it will do on bevels. If you'll want to bevel two-by-fours, be sure your saw has the capacity—*in its tilted position.*

Good table size is another must, since today's jobs call for a lot of panel cutting. A small table not only makes large work hard to handle—it can actually affect cutting accuracy. Check, too, on the availability of extra front and side extensions—you're almost certain to want them eventually.

With accessories, a table saw becomes an even more

CONTINUED

Six features to look for in a good saw

1. **Good depth of cut** with the blade **in** both straight and fully **tilted** positions.

2. **Sturdy construction** with a smoothly ground steel table and precision-cut slots.

3. **Big controls** that are easy to manipulate, with clear tilt and height calibrations.

4. **Large table area** with extensions available to increase the size as needed.

5. **A rip fence** that adjusts smoothly and precisely and locks quickly at any point.

6. **A miter gauge** that slides easily yet snugly, has clear markings, locks tightly.

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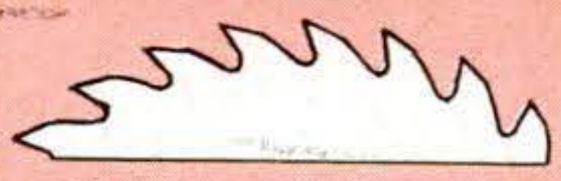
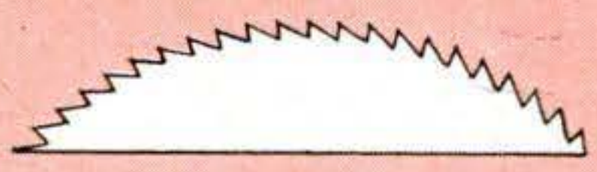
TABLE SAW

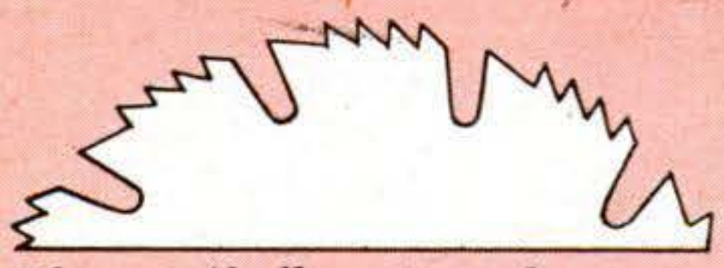
There's a saw blade for every cutting job



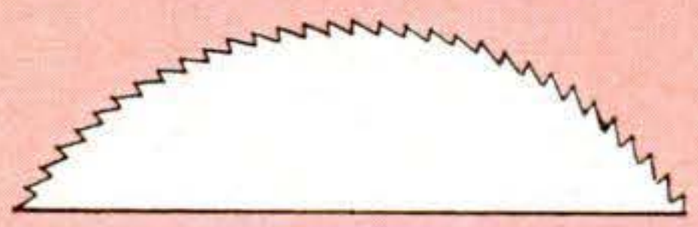
Rip: Flat-ground for general rip-cutting with the grain.



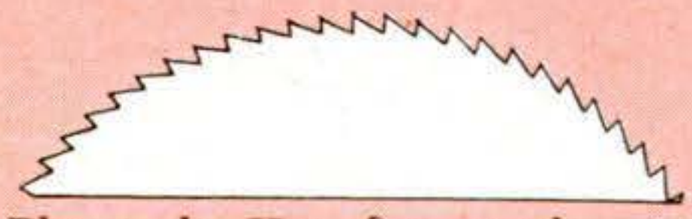
Crosscut: Flat-ground for general cutting across grain.



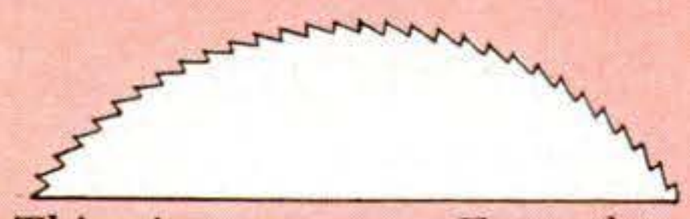
Planer (hollow-ground combination): Smooth-cutting general blade for both rip and crosscuts. Cheaper flat-ground combination also available.



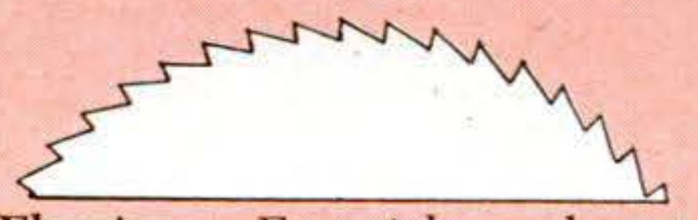
Fine-tooth: For cutting plywood and composition boards without splintering edges.



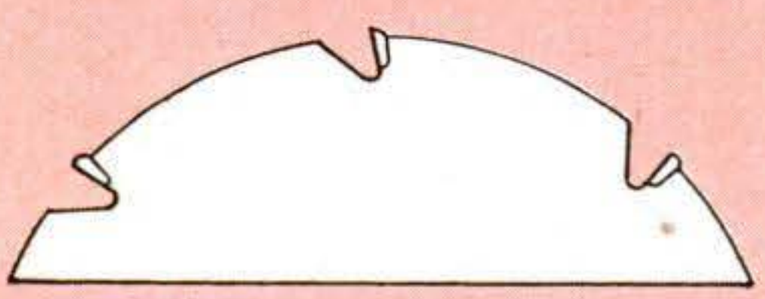
Plywood: Has fine teeth, as above, but is made especially for smooth cuts in plywood.



Thin-rim veneer: Extra-thin at rim for fine finish cuts and invisible glue joints.



Flooring: For jobs where blade may hit an occasional nail, as in old flooring.



Carbide-tipped: Extra-fast and long-wearing; good for tough composition materials.

versatile shop tool. Fancy moldings are a breeze to shape with a molding head mounted on the arbor. Dado cutters make short work of grooving, rabbeting, and tenoning. Replace the blade with a sanding plate and you have a disk sander. Note, too, that some saws are designed for use with a companion jointer—a handy way to get double use from a single motor.

Quick Facts About TABLE SAWS

MAKE	MODEL	BLADE SIZE (in.)	DEPTH OF CUT (in.) At 90°	DEPTH OF CUT (in.) At 45°	TABLE SIZE WITHOUT EXTENSIONS (in.)	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)	SAW-JOINTER COMBINATION AVAILABLE
AMERICAN MACHINE & TOOL	21651	8	2¼	1⅝	10½x13	¼	$20	no
	2164	8	2¼	1⅝	10½x13	¼	$25	
BOICE-CRANE	3510	10	3¼	2¼	36x27½	1-3	$325	yes
	4500	10	3 1/16	2 1/16	20x27½	1-2	$189	
COMET	12-A-63	12	4	3	22¾x30	1-2	$387	yes
DELTA-ROCKWELL	34-600	9	2¾	2	22x15	¾-1	$105	yes
	34-200	7¼	1 11/16	1¾	14x10½	½	$80*	
DEWALT	130	10	3⅛	2⅛	20x27½	¾-1	$160	no
	140	10	3⅛	2⅛	27½x35	1½-3	$330	
DURO	MS3011	8	2⅜	1⅝	11¾x14⅝	½	$65	yes
	F3013	8	2⅜	1⅝	17⅛x13	½	$79	
	PG3012	9	2⅞	2	20¼x15	½	$118	
MONTGOMERY WARD	84C3369M	7¼	1⅝	1	10x14	½	$60*	yes
	84C3331MO	8	2½	1¾	14x17	½	$54	
	84C3333R	10	3½	2⅜	20x27	¾	$110	
	3225	8	2⅛	1⅜	14x16¾	¾*	$249**	
POWERMATIC	6500-01	10	3⅛	2⅛	28x38	1½-3	$325	no
SEARS CRAFTSMAN	99G2424L	8	2¼	1⅝	14x17	½	$57	yes
	99G2218L	9	3	2⅛	17x20	½-¾	$87	
	99G2999N	10	3⅜	2⅜	27x20	¾-1	$112	
	99G2245N	10	3¼	2¼	20x27	1-1½	$242	
SHOPMASTER	HM-4	8	2½	1⅝	13x16	½	$80	yes
	HM-2	8	2½	1⅝	16x23	½	$90	
	HM-8	8	2½	1⅝	16x30	½	$160*	
	TA-8A	8	2½	1⅝	20x33	¾	$160	
SHOPSMITH (Magna-American)	MARK 5	9	2½	2⅜	14x18⅜	1⅛*	$320*	yes**
	MARK 7	10	3 11/16	2¾	14x21	1⅛*	$370*	yes**
TOOLKRAFT	32A	8	2½	1⅝	14⅛x17¼	½	$75	no
	36B	8	2 3/16	1¾	16x20	¾	$90	
	89B	9	3⅛	2⅛	16x20	¾	$100	
	815A	8	2½	1⅝	14⅛x17¼	¾	$115	
	825A	8	2½	1⅝	16x20	¾	$130	
	829A	9	3⅛	2⅛	16x20	1	$150	

*Includes built-in motor. **Multipurpose tool.

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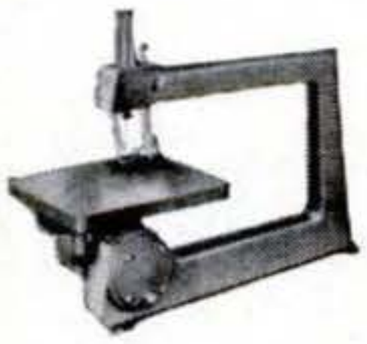
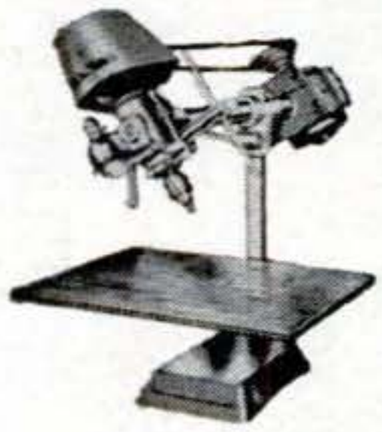


Delta 16″ Scroll Saw
Model No. 40-100

Delta 4″ Deluxe Jointer
Model No. 37-290



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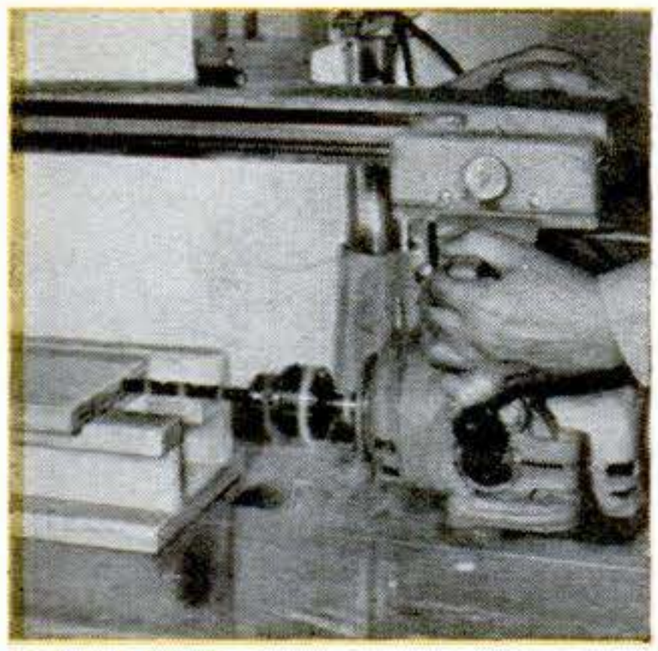
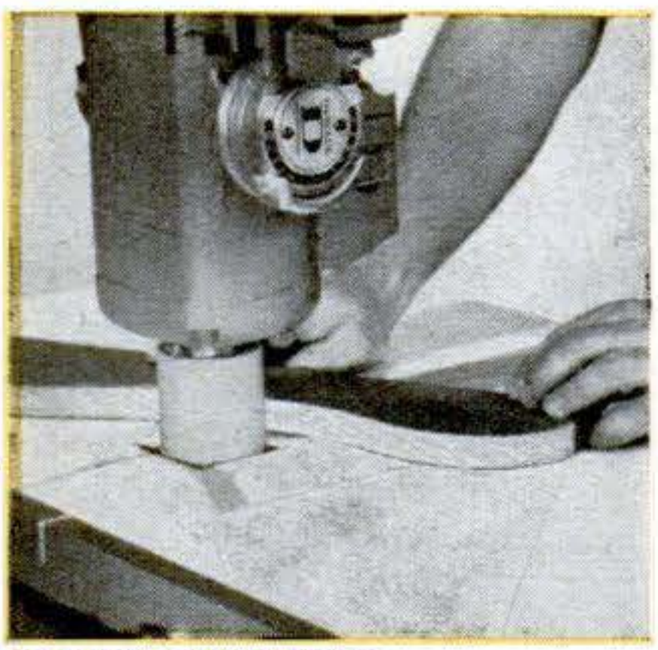
RADIAL-ARM SAW

its bagful of tricks makes it almost a shop in itself

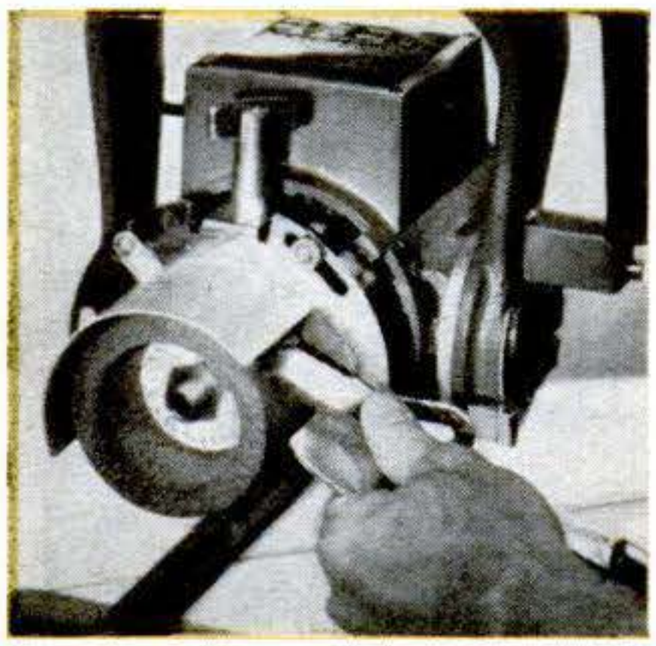
Some of the many jobs it can do



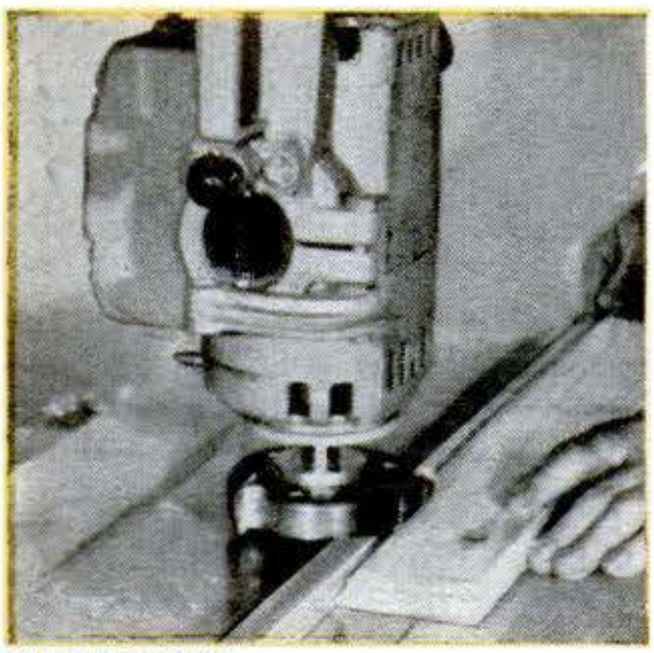
DRILLING



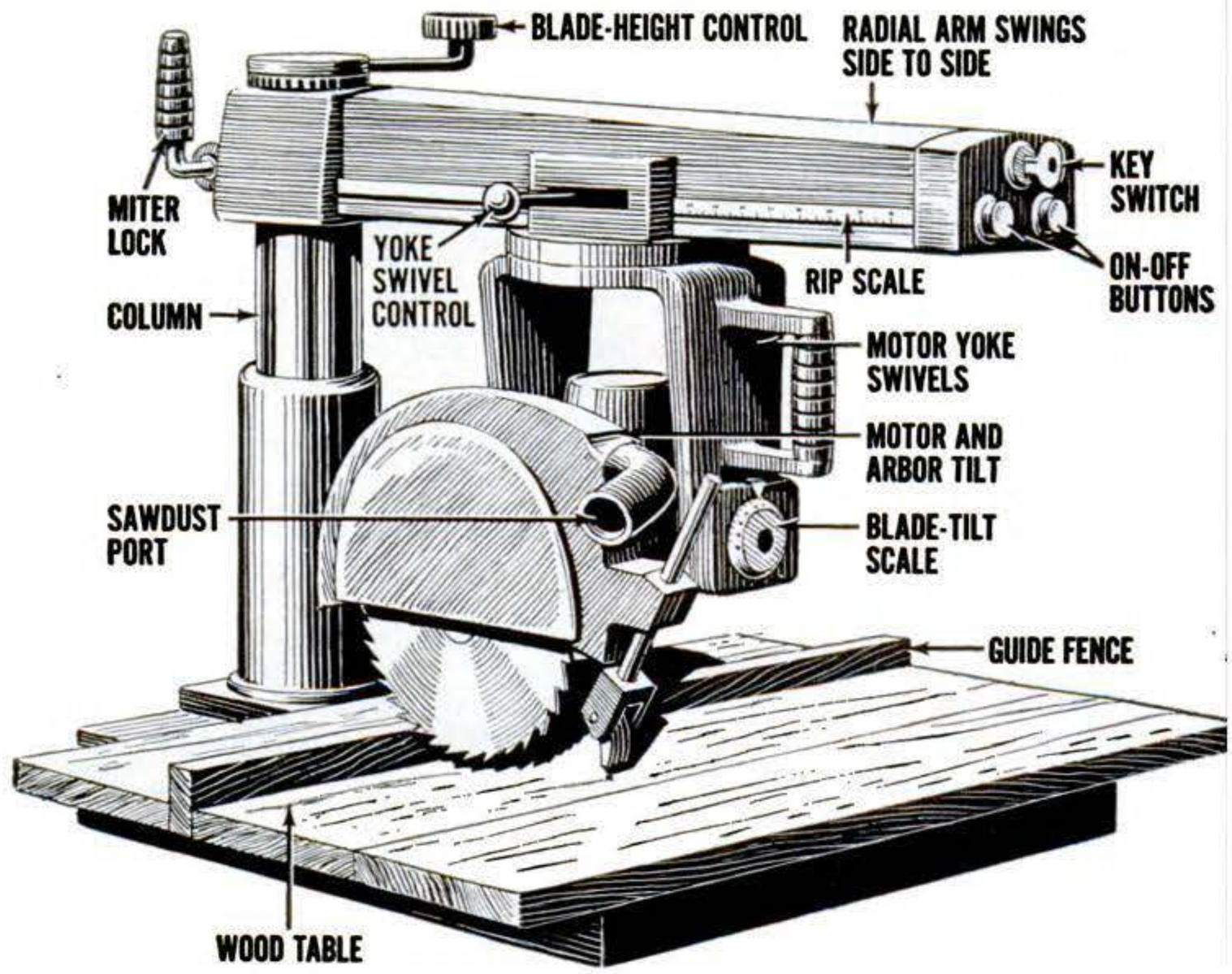
DRUM SANDING



GRINDING



MOLDING



SOMETHING new burst on the workshop world a few years ago—a circular saw that slid on tracks above the work. Then people began to figure out what else this setup might do. The result is today's radial-arm saw, almost a workshop in itself. It has immense capacity for all standard sawing jobs and some offbeat ones (such as bowl-like concave cuts).

Add accessories for disk and drum sanding, boring, grinding, planing, shaping, and routing, and you have a multipurpose machine that can be stowed in a three-foot-square corner and costs less than separate tools.

Some radial-arm saws have a hearty appetite for four-by-fours. Most can whisk through two-by-fours at 45 degrees. All will rip to the center of a four-by-eight panel, some with considerable margin. Crosscut capacity in 1″ stock ranges from 12″ to 20⅝″.

The radial-arm saw has an upright or column that carries a horizontal overarm. This is vertically adjustable to vary saw height above the table, and thus the depth of cut. The generously sized table is of wood so that the blade may safely cut through the work.

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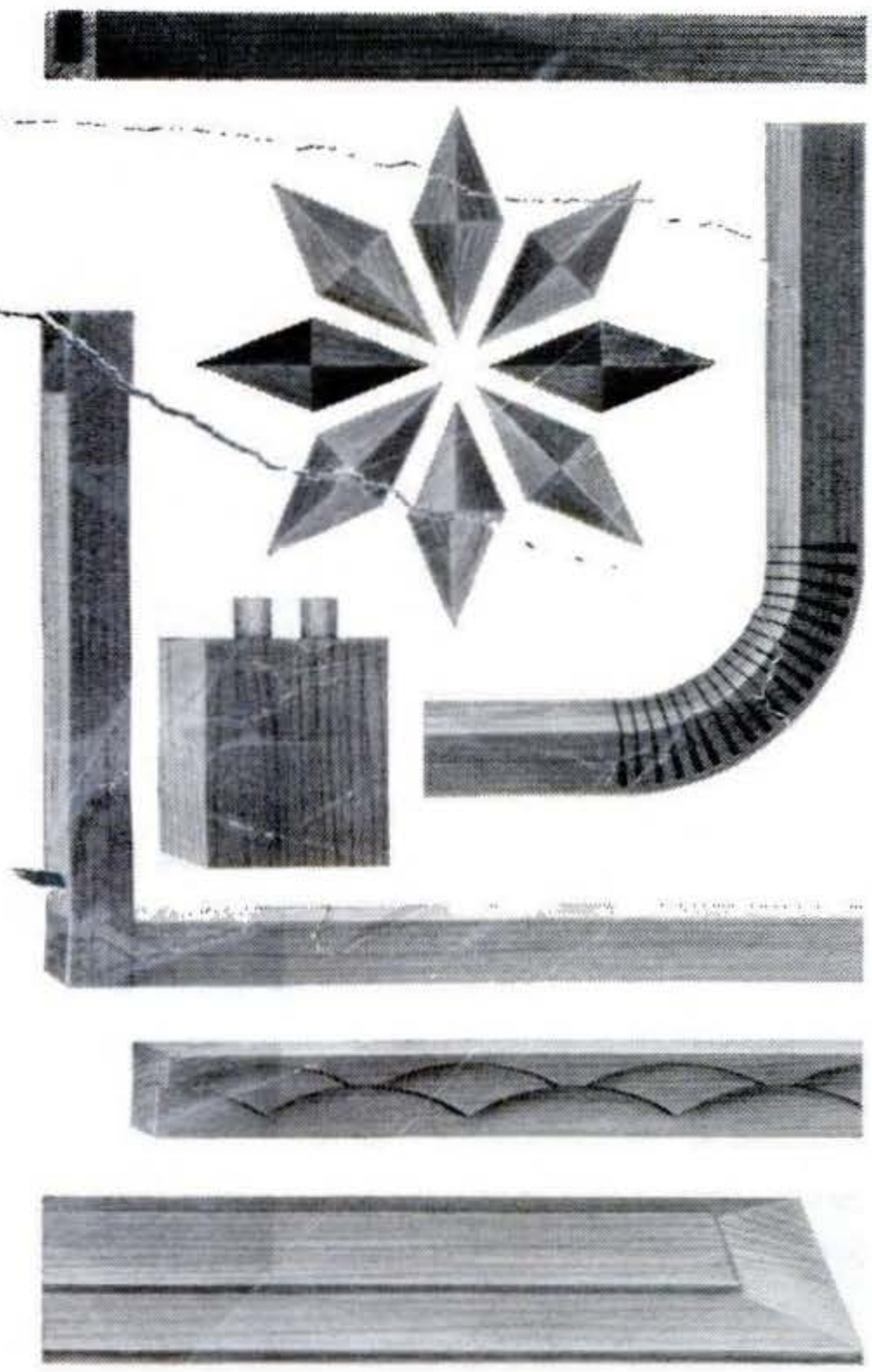
A short cut to expert woodworking: A DeWALT POWER SHOP®



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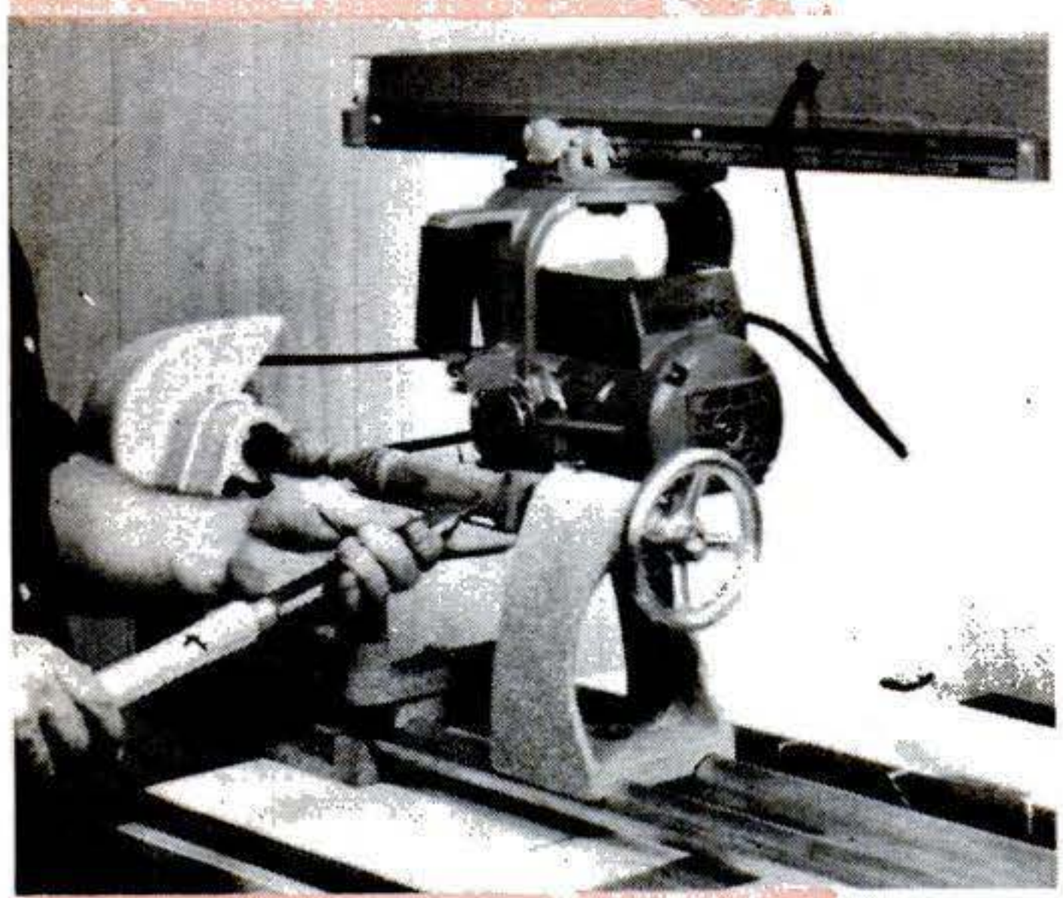
RADIAL-ARM SAW



It runs other tools, too

A versatile performer in itself, the radial saw also serves as a power head for other tools. Here it belt-drives a small wood lathe.

For crosscutting and dadoing, the workpiece is held against a wooden fence (also adjustable) and the blade pulled across it. To make bevel crosscuts, the blade is tilted. For plain or bevel ripping, the blade is swiveled parallel to the fence and locked fast, and the work is fed into it much as on a table saw. The track arm can also be swung horizontally for right or left miter cuts; for compound or bevel miters, the blade is simply tilted, too.

Some radial-arm saws have the carriage track directly on the overarm, which swings from the column for angle cuts. One has the motor head fixed on two bars that slide in bearings on top of the column. Other machines have a second, center-pivoted arm under a fixed overarm. The carriage track is on the lower arm.

For such work as routing, the motor head is turned with its spindle vertical. As no single speed is ideal for all operations, some makers provide extra spindles driven at different rates by enclosed gears or belts.

Quick Facts About RADIAL-ARM SAWS

MAKE	MODEL	BLADE SIZE (in.)	DEPTH OF CUT (in.)		LENGTH OF CROSSCUT (maximum in 1" stock; in.)	WIDTH OF RIP (in.)	HEIGHT CONTROL FRONT- OR COLUMN-MOUNTED	TABLE SIZE (in.)	NUMBER OF SPINDLES	SPINDLE SPEEDS		BUILT-IN MOTOR (hp.)	APPROX. PRICE
			At 90°	At 45°						No.	R.P.M.		
COMET	F-5	9	2½	2	12	25	column	20¾x40	2	2	6,500 10,500	1	$269
	UBD-5	8	2½	2	12	24	column	20¾x40	2	2	6,700 11,500	1¼	$329
DELTA-ROCKWELL	33-930	9	2½	2	15	24	front	32x27	2	1	3,450	1	$259
	33-900	10	3	1⅝	14½	24	front	32x27	2	1	3,450	1	$269
	33-582	10	3	1⅝	16	25	column	22x30	1	1	3,450	1½	$383
DEWALT	1200	9	2½	1⅞	13	24 13/16	column	21 11/16x32	2	1	3,450	1.8	$239
	1400	10	3	2⅛	14½	24 11/16	column	26 13/16x32	2	1	3,450	2*	$269
	1501	10	3	2¼	16	27	column	29x38½	2	1	3,450	3*	$439
MONTGOMERY WARD	84C2296R	10	3⅞	2¾	16⅛	27⅛	column	24½x36	3	3	3,450 10,000	1	$179
	84C2313R	10	3	2	15½	24	column	32x21	1	1	3,450	1	$238
SAWSMITH (Magna-American)	Sawsmith	10	3½	2½	20⅝	27	front	18x36	2	7	1,700 6,400	1⅛	$259
SEARS CRAFTSMAN	99G2931N	9	3⅛	2⅜	15	24⅛	column	20x31¾	2	1	4,100	1	$149
	99G2940N	10	3½	2⅛	16	24	front	20⅝x40	2	1	3,450	1⅛	$209
SHOPMATE (Portable Electric)	5100	10	3⅞	2¾	16	27¼	column	24½x36	3	3	3,450 10,000	1	$190
	5090	9	3⅜	2	16	27½	column	24½x36	1	1	5,000	1	$160
TOOLKRAFT	925	9	3⅛	1¾	18	29¼	front	24½x32	2	1	4,200	¾	$250
	950	10	3⅝	2	18	29¼	front	24½x32	2	1	4,200	1	$270

*Indicates developed hp. (somewhat higher than rated hp.).

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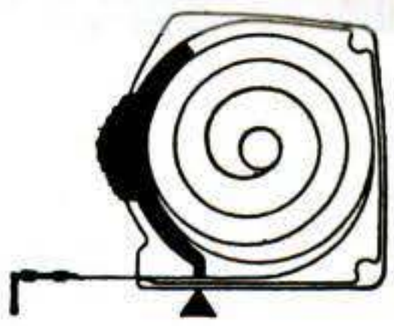
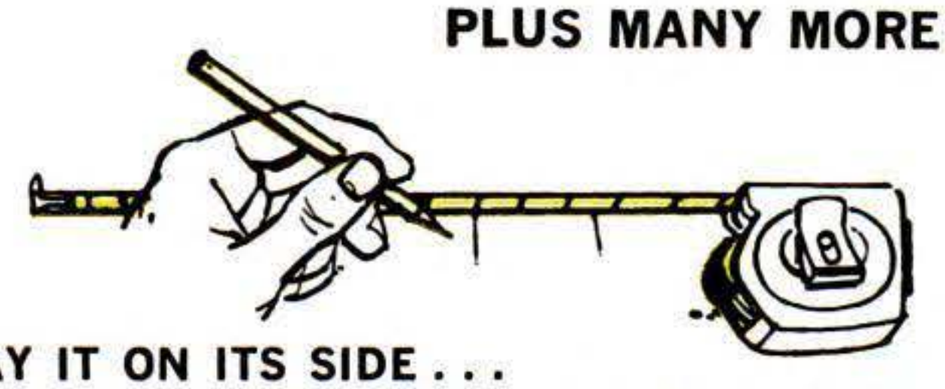
*DuPont trade-mark for its polyester film

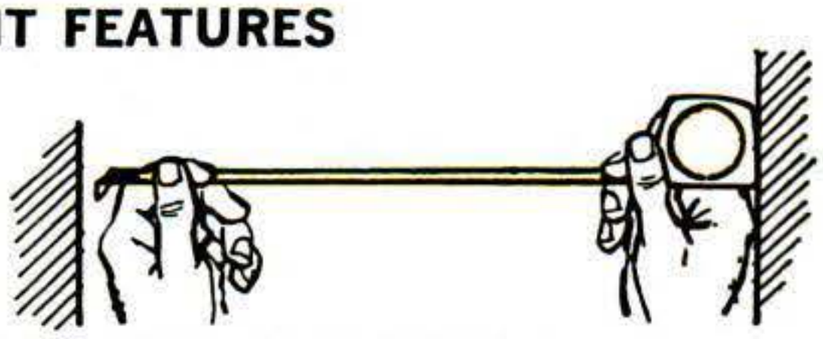
MUCH MORE THAN JUST ANOTHER LOCKING DEVICE . . . exclusive Stanley Powerlock is the **only** device of this type that locks on the blade, not the drum, positively prevents creep, eliminates slippage in both directions!



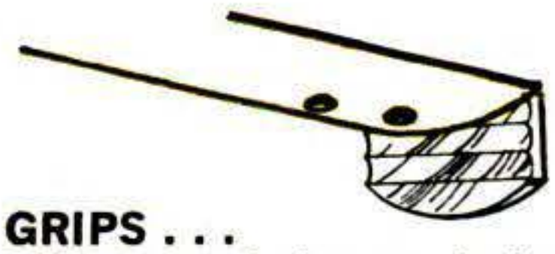
PLUS MANY MORE IMPORTANT FEATURES



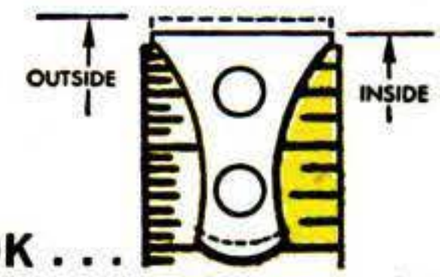
LAY IT ON ITS SIDE . . . rule lies flat; easy to mark off. Blade stays put. Doesn't snap back.



EASY "INSIDE" MEASURING . . . just use as shown, adding exactly two inches to reading for width of case.



HOOK THAT GRIPS . . . because serrations and burrs help prevent it from slipping off smooth surfaces. Strong too; 100 pound pull won't bend it.



TRUE ZERO HOOK . . . slides automatically, allowing precisely for its own width taking inside or outside measurements.

Why settle for almost-as-good . . . when the very finest—genuine Stanley Life Guard Yellow Rules—cost no more. At better stores everywhere.

STANLEY—THE TOOL BOX OF THE WORLD

THE STANLEY WORKS / NEW BRITAIN, CONNECTICUT

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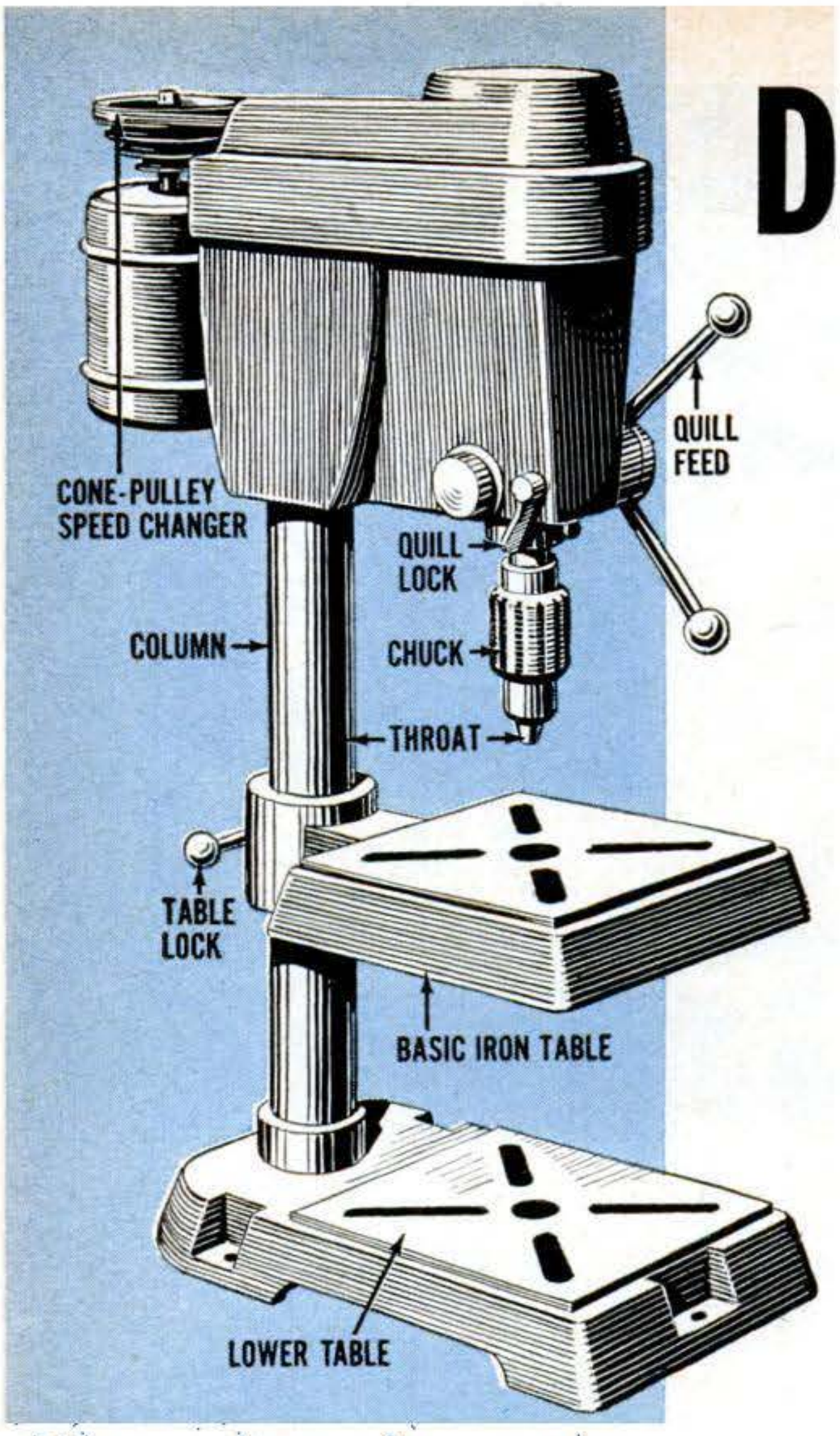

DRILL PRESS

a precision hole-maker, it's also a sander, shaper, and router

WHETHER you work in wood or metal, a drill press should stand high on your most-wanted-tools list. It will enable you to spot holes precisely and assure you of drilling them at exactly 90 degrees. If one must be made at some other angle, the proper drill-press setup will get it right the first time.

But this tool will do far more than make holes. It will serve for planing, sanding, and even shaping wood. With it the craftsman can do plain and fancy routing, form molded edges, cut accurate mortises and dovetails, do fluting and reeding, and even cut dowels and plugs from the very wood they are to match.

The man who works in metal can use his drill press for wire-brushing, light milling, keyway-cutting, accurate tapping, surface-grinding, honing, lapping, and spot-finishing. For good measure it will do such offbeat chores as drilling glass or ceramic, spinning over hollow rivets, and mixing paint.

Drill-press capacity is commonly rated by throat depth—the distance from spindle center to column. This determines the size of work it can handle. The spindle travel determines the depth you can drill without resetting the table. Speeds should go up to 5,000 r.p.m.—necessary if you'll want to use shaper cutters and router bits. For metalwork, very low speeds can be obtained by installing a larger cone pulley or an intermediate jackshaft.

A tilting table is convenient for angle-drilling, but shop-made jigs can be used if the table doesn't tilt. It should be precisely square to the spindle in its horizontal position. As a rough test, chuck a stiff wire bent to just touch a table corner. Turn the chuck by hand; the wire should touch or miss all four corners to the same degree. For maximum accuracy, use a bar-mounted dial indicator to check this.

A comparatively recent development is the radial-arm drill press. Its head is mounted on a horizontal arm that slides back and forth in a socket on top of the column. The head also swivels off the edge of the table for end-drilling long work, and tilts either way for drilling, routing, sanding, or shaping at an

Five features to look for in a good drill press

1. Strength and rigidity. The table should not deflect under moderate load. Spindle should have no side play.

2. A sturdy chuck. A geared key chuck is strongest, most accurate for drilling. For jobs involving side thrust, like routing, use a type that threads on.

3. True table alignment. It must be precisely square with the spindle.

4. The right speed range. Most machines have suitable woodworking speeds. Investigate available speed reducers for metalwork.

5. A reliable depth stop. It can be set to limit drilling depth or locked to hold the quill at any extension.

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angle. Four of the machines listed below are of this type.

As they operate vertically, motors should be of the sealed ball-bearing type, which are best able to withstand end thrust and won't leak out their bearing lubricant. It is inadvisable to use a motor smaller than the manufacturer recommends, especially if much of the work to be done calls for high speeds.

Quick Facts About DRILL PRESSES

MAKE	MODEL	DEPTH OF THROAT (in.)	SPINDLE TRAVEL (in.)	SPEED RANGE (r.p.m.)	NO. OF SPEEDS	CHUCK CAPACITY (in.)	TABLE SIZE (in.)	MAX. DISTANCE TABLE TO CHUCK (in.)	TYPE OF BEARINGS	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
AMERICAN MACHINE & TOOL	253	16****	2¾	800-3,500	3	½	7x9	15	ball & sleeve	¼-⅓	$30
BOICE-CRANE	1650	7½	4	500-5,500	5	½	10x11	12¼	ball	½	$132
	1670	7½	4	500-5,500	5	½	10x11	41¾	ball	½	$147
CLAUSING	1620	7½	4¾	400-5,400	5	½	10x14	14¼	ball	½	$145
	1640	7½	4¾	400-5,400	5	½	10x14	41¾	ball	½	$150
DELTA-ROCKWELL	11-100	5½	3⅝	700-4,700	4	½	8½x9	11	ball	⅓	$75
	11-280	16⅜****	3⅝	700-4,700	4	½	23¾x15⅞	10½	ball	⅓	$90
	11-000	5¼	3	800-4,000	3	½	7¾x11	6½	ball	½	$80*
DEWALT	320	7½	4	580-5,200	4	½	10x10	12	ball	⅓-½	$130
	330	7½	4	580-5,200	4	½	10x10	41	ball	⅓-½	$140
DURO	F3083	7	3⅝	780-3,800	4	½	7½x7½	10¼	ball & sleeve	⅓	$85
MONTGOMERY WARD	84C2530M	5¼	3	800-4,000	3	½	7¾x11	6½	ball	½	$70*
	84C2577R	16⅜****	3⅝	700-4,700	4	½	23¾x15⅞	10½	ball	⅓	$87
	84C2588F	7½	4⅛	600-5,200	9	½	9x9	13¾	ball	⅓	$97
	84C2587F	7½	4⅛	600-5,200	9	½	9x9	41¾	ball	⅓	$109
	3225	8¼	3	1,700-6,400	**	½	14x16¾	23	ball	¾*	$249***
POWERMATIC	1150-48	7½	6	400-5,300	5	½	10x14	21¾	ball	½	$144
	1150-47	7½	6	400-5,300	5	½	10x14	37¼	ball	½	$149
SEARS CRAFTSMAN	99G2359N	6⅛	3	765-4,000	9	½	7¾x7¾	7 1/16	ball	⅓	$63
	99G2450N	7¾	4	610-5,000	9	½	10x10	13⅞	ball	½	$103
	99G2451N	7¾	4	610-5,000	9	½	10x10	38¾	ball	½	$118
SHOPMASTER	DP-600	6	3	862-3,450	4	½	7½x7½	10	ball	⅓	$72
	DP-600F	6	3	862-3,450	4	½	7½x7½	44	ball	⅓	$80
	DP-24A	24****	3	862-3,450	4	½	8¼x8¼	9 11/16	ball	⅓	$120*
SHOPSMITH (Magna-American)	MARK 5	8¼	4½	700-5,200	**	½	14x18⅜	26	ball	1⅛*	$320***
	MARK 7	8¼	4¼	700-5,200	**	½	14x21	23¼	ball	1⅛*	$370***
SOUTH BEND	CD400B	7⅛	4	720-4,325	4	½	10x10	11⅜	ball	⅓-½	$140
	CD400F	7⅛	4	720-4,325	4	½	10x10	40¾	ball	⅓-½	$162
TOOLKRAFT	350B	6	3	862-3,450	8	½	7½x8½	9 11/16	ball & sleeve	⅓	$75
	357A	7⅞	4⅛	862-3,450	8	½	9¼x9	14	ball	½	$100
	360A	7⅞	4⅛	862-3,450	8	½	11x10	44	ball	½	$120

*Includes built-in motor.
**Continuously variable.
***Multipurpose tool.
****Radial-arm type.

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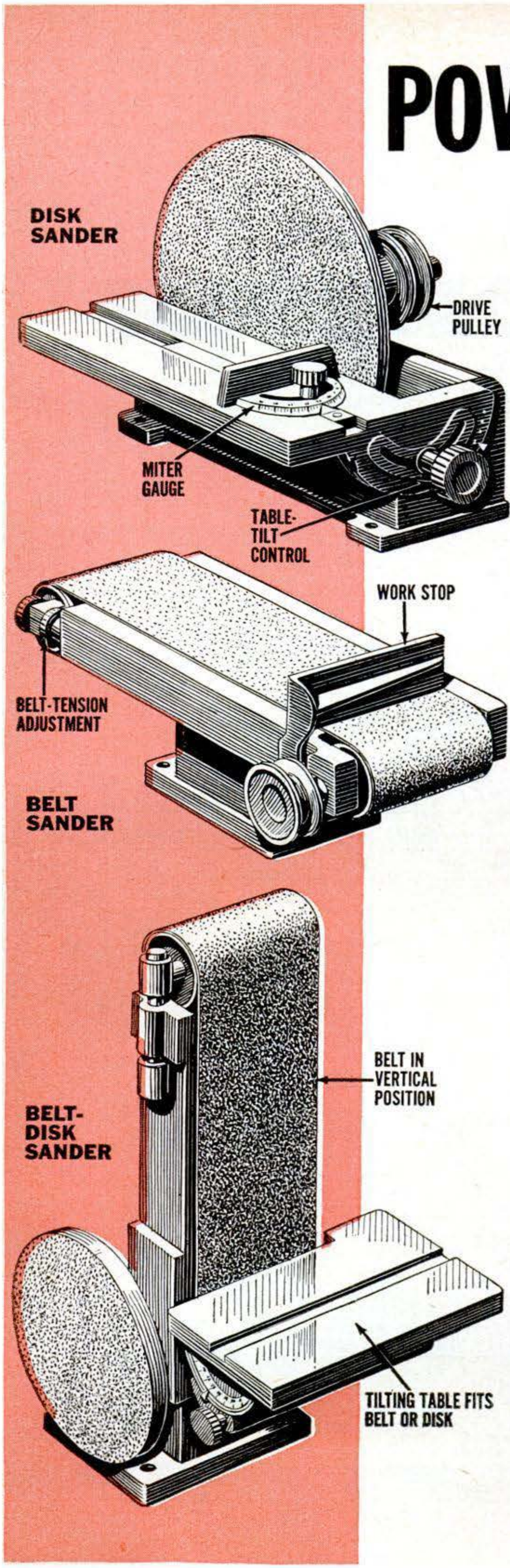
POWER SANDERS

you have a choice of three types



A POWER sander is one of the most versatile tools you can own, yet it's often overlooked. It's not just a convenience that does by motor what you could do in a little more time by hand. Actually, it's a precision *shaping* tool that, teamed with a saw, becomes the real basis for accurate fitting and joining.

A disk sander, with its rigid plate set square to the table, is capable of machining dead-flat surfaces on both wood and metal—something you could never do by hand. It will square an edge, form perfect bevels and chamfers, and shape outside curves. With the proper abrasive, it's also a grinding wheel for metals.

A belt sander, with its continuous belt running in one direction, provides a straight-line sanding action for fine, with-the-grain smoothing, not possible on a disk. You can also shape inside curves against the drum at either end.

The combination belt-disk sander gives you the advantages of both tools in one. Although it costs somewhat more than either type by itself, its all-around versatility makes it the top choice for a well-equipped shop.

The belt in a belt-disk combination also offers features not found on most single-purpose belt sanders. It can be tilted to any angle from flat to vertical for bevel sanding. In its vertical position, it can be used with the disk-sander table for precision shaping, squaring, and mitering. The slack side of the belt at the back can also be used for freehand sanding of contours.

The two most important points to check on a belt sander are belt width and the size of the belt backup plate. These determine the working area, and the bigger the better. A 4″ belt is fine for most jobs;

CONTINUED

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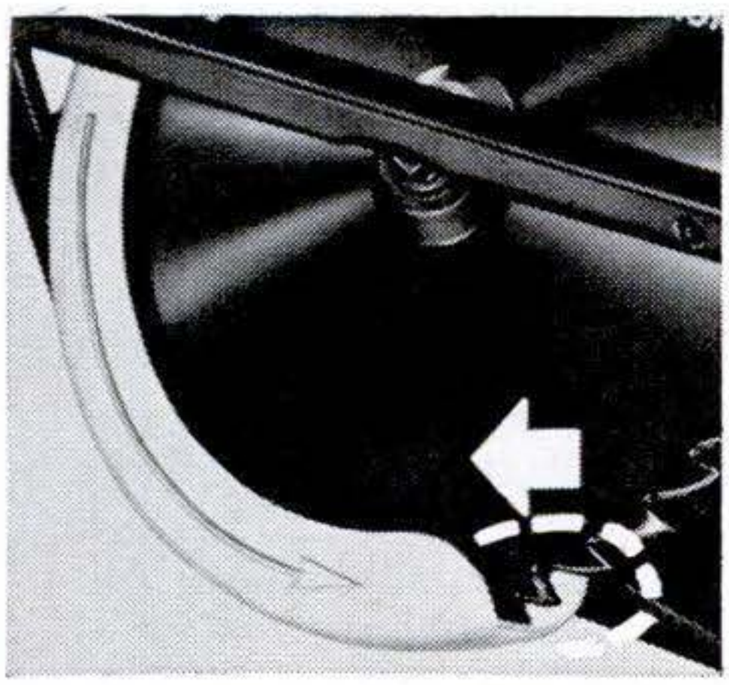
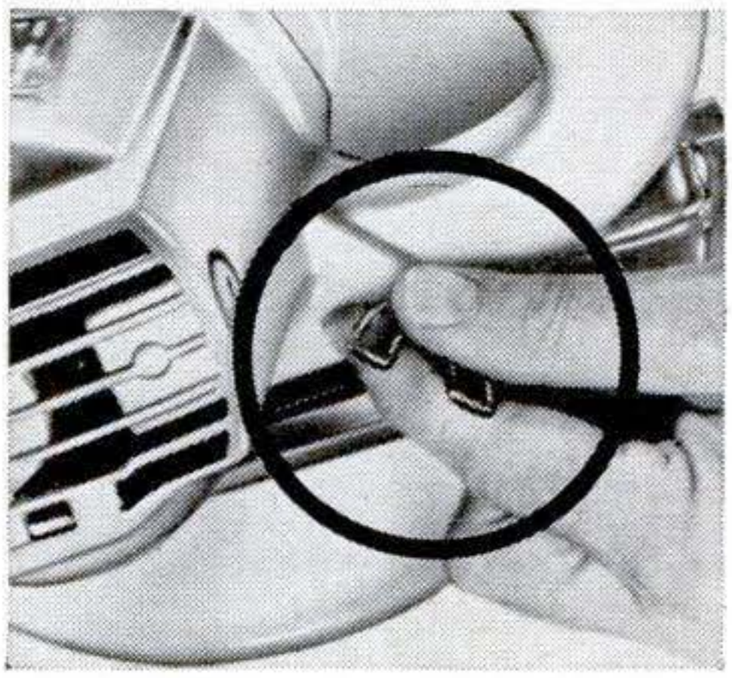
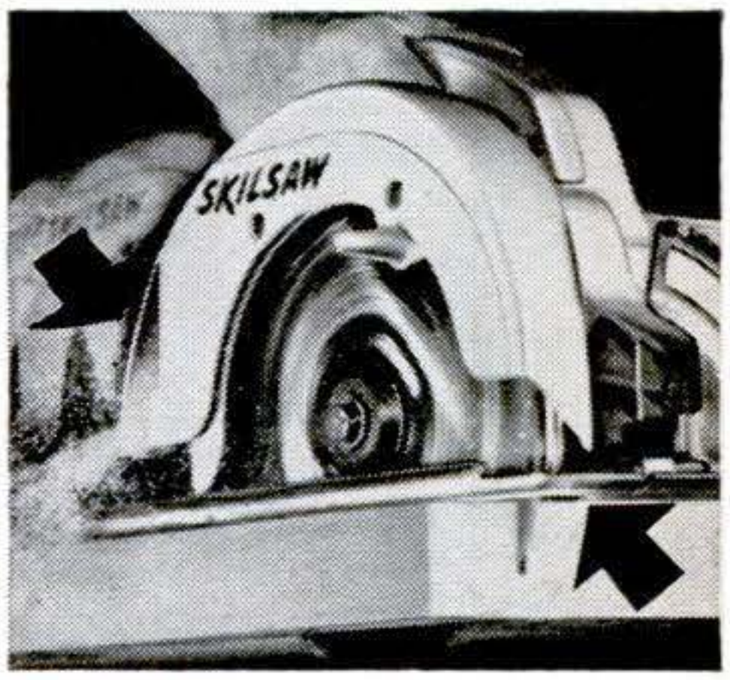
6 REASONS WHY SKILSAW POWER SAWS OUTSELL EVERY OTHER MAKE!



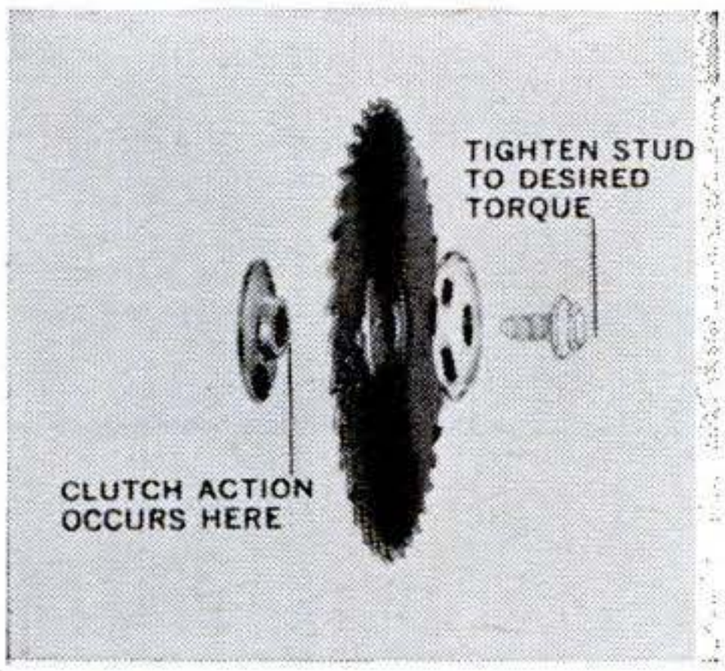
Bind-free lower guard—Retracts automatically when saw base is tilted, thus allowing bind-free starts—even on compound miter cuts.



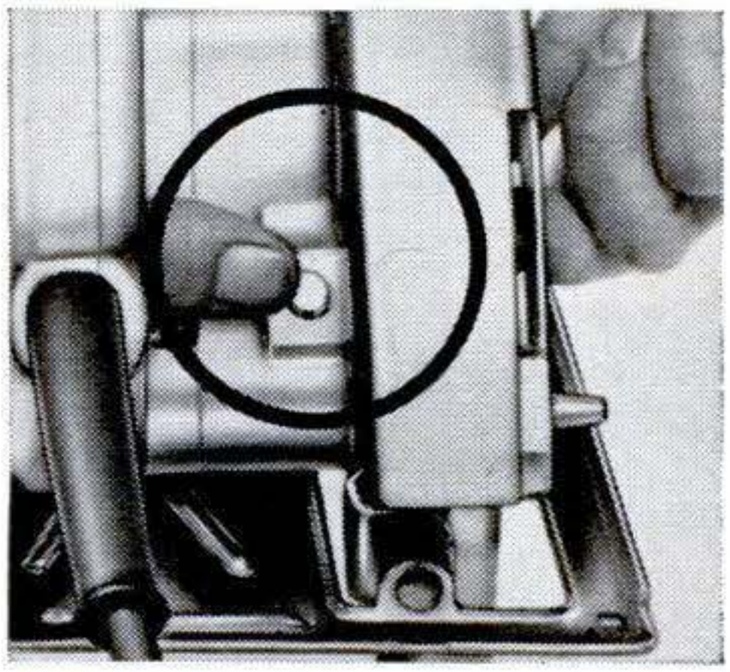
Easy-to-set depth control—Conveniently located for easy one hand adjustment. Control locks the saw firmly and quickly at any desired cutting depth.



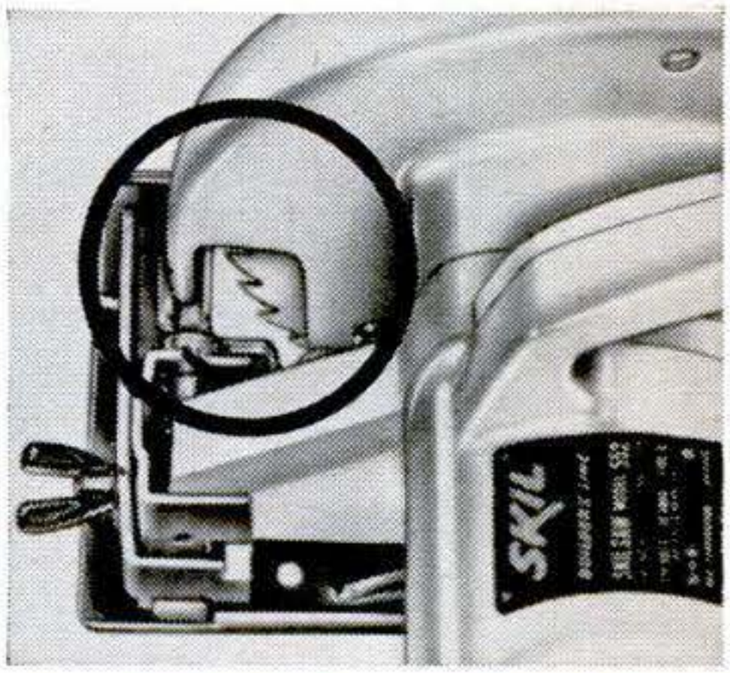
Exclusive sawdust ejection—Special air stream ejection system directs sawdust down to floor, away from the operator; blows it off the line of cut.



Vari-Torque safety clutch—Disengages blade if it binds or jams. Protects gears and other parts from damage, prevents saw kick-back.



Exclusive Blade Lock* (Patented Feature) For fast, easy blade changes. Push-button engages and locks blade shaft for greater user safety.



Full-View Blade—Upper blade guard designed to allow clear view of blade all through the cut for absolute precision and accuracy.

Skilsaw Model 536—World's largest-selling 6½" saw. Makes 45° bevels in 2" lumber, has super burnout protected motor. Other models up to 8¼".

There are many more features, too! Like super burnout protected motors on *all* models, and full ball-bearing construction on heavy-duty models.

Because Skil never compromises on quality, no other saw offers all these features to make every cutting job easier and faster.

Skilsaw Power Saws are made in both deluxe and heavy-duty models with full range of blade sizes from 5½" to 8¼". See them at your nearby lumber and hardware store. Prices start under $30—slightly higher in Canada.

SKIL POWER TOOLS

** available on heavy-duty models only*

WATCH ALL-PRO SCOREBOARD SPONSORED BY SKIL ON ABC-TV SUNDAY, SEPT. 15—DEC. 15.

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How to choose belts and disks

MATERIAL	GRIT SIZE TO USE		TYPE OF ABRASIVE
	ROUGH CUTS	FINISH CUTS	
SOFTWOOD	40-60	80-100	Garnet
HARDWOOD	50-80	120-180	Aluminum oxide
STEEL	50-80	100-180	Aluminum oxide
CAST IRON	40-60	80-150	Aluminum oxide
STEEL CUTTING TOOLS	60	150-180	Aluminum oxide
CARBIDE CUTTING TOOLS	60*	150-180	Aluminum oxide
STAINLESS STEEL	80	100-220	Aluminum oxide
ZINC, ALUMINUM, BRASS, BRONZE	36-80	120-220	Aluminum oxide or silicon carbide
GLASS, PLASTICS, MARBLE, STONE, CERAMICS, BONE	80-150	180-400	Silicon carbide

*Silicon carbide preferred for roughing.

6″ is a luxury you'll appreciate on wide-board surfacing. Most models have an adjustable stop at right angles to the belt to support the work. Some also have a guide fence parallel to the belt—a handy extra.

On disk sanders, plate diameter and table size are the points to look for. A good-size disk is important not so much for its total area as for the working width it gives you across the middle. The wider the disk, the better it supports the work and prevents rocking. A large table is important for the same reason. It should tilt to 45 degrees for bevel sanding and should have a miter gauge so you can slide square and miter work accurately across the disk.

Abrasive belts and disks are available in many types and grit sizes to suit almost any material. The chart at left can help you pick the right one for each job.

Quick Facts About POWER SANDERS

MAKE	MODEL	TYPE	BELT WIDTH (in.)	BELT LENGTH (in.)	BELT DRUM DIA. (in.)	BELT BACK-UP PLATE SIZE (in.)	DISK DIA. (in.)	TABLE SIZE (in.)	TYPE OF BEARINGS	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
DELTA-ROCKWELL	31-200	disk	—	—	—	—	8½	4⅛x9⅞	sleeve	⅓	$22
DEWALT	630	belt-disk	4	37½	3¼	4¼x11⅞	10	7⅜x15	ball	½	$130
DURO	A3064	belt	4	36	2 3/16	4 7/16x11	—	—	sleeve	⅓	$25
	B3066	belt	6	48	3	6½x16	—	—	needle	⅓	$47
MONTGOMERY WARD	84C2710MO	belt-disk	6	48	3	6½x16½	9	6¼x12	sleeve	½	$57
	84C2705M	belt	4	36	2½	4½x12	—	—	sleeve	⅓	$19
	3225	disk	—	—	—	—	9	14x16¾	ball	¾	$249*
POWERMATIC	350-01	disk	—	—	—	—	12	10x16½	ball	½-¾	$72
	330-01	belt	6	48	4½	6⅝x15½	—	—	ball	¾-1	$134
	300-01	belt-disk	6	48	4½	6½x15½	12	10x16½	ball	¾-1	$145
SEARS CRAFTSMAN	99G2236C	belt	4	36	2½	4⅜x12	—	—	sleeve	⅓	$19
	99G2254L	belt-disk	6	48	3	6½x17 9/16	9	6¼x12	ball	½	$60
SHOPMASTER	SR-5600	belt-disk	4	34	3	4¼x9½	5	None	sleeve	⅓	$40
	SR-1000	belt-disk	6	48	3½	6⅛x17	10	5¾x12⅜	sleeve	½	$100
SHOPSMITH (Magna-American)	MARK 5	disk	—	—	—	—	12	14x18⅜	ball	1⅛	$320*
	MARK 7	disk	—	—	—	—	10	14x21	ball	1⅛	$370*
TOOLKRAFT	335	belt-disk	6	48	3	6½x16½	9	6¼x12	sleeve	½	$75

*Multipurpose tool with motor built in.

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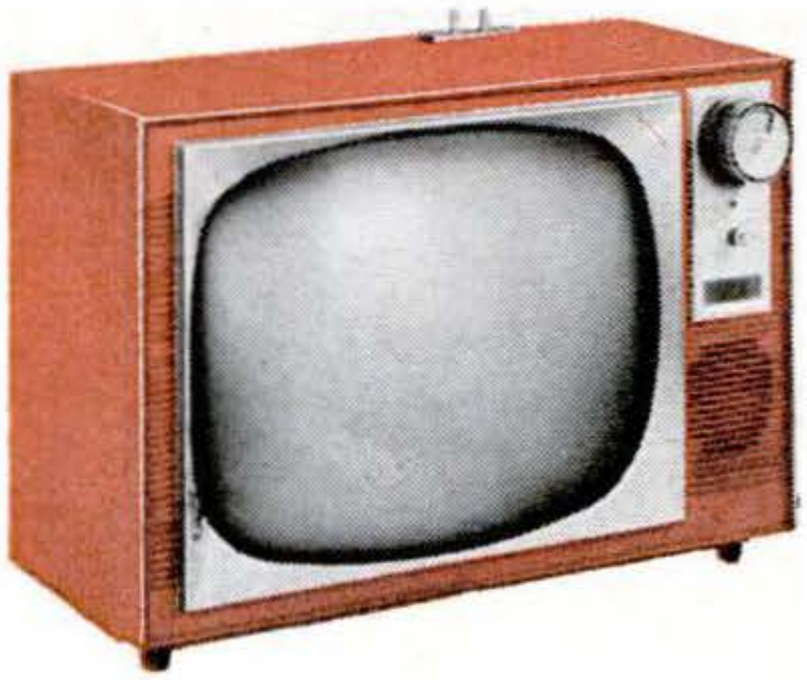

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How to choose the best blade for the job

7-tooth narrow: For rough cuts in fairly thick plastics, hard rubber, ivory over ¼".

7-tooth wide: For coarse, heavy cuts in wood, plywood, wallboard, composition boards.

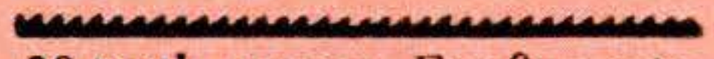
10-tooth: For fairly coarse, heavy cuts in softwood, hardwood, composition boards.

12-tooth: For fairly fine cuts in medium-thick plastics, plywood, hard rubber up to ½".

15-tooth narrow: For nonferrous metals, mild steel, asbestos from ⅛" to ¼" thick.

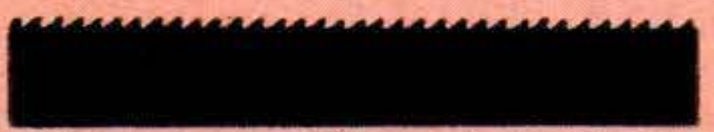
15-tooth wide: For coarse cuts in plastic laminates and nonferrous metals up to ½" thick.

18-tooth: For fairly fine, smooth cuts in thin wood and plastics up to ⅛" thick.



20-tooth narrow: For fine cuts in plastics, plywood, wood veneers up to 1/16" thick.

20-tooth medium: For thin ferrous and nonferrous metals, other hard materials up to ⅛".

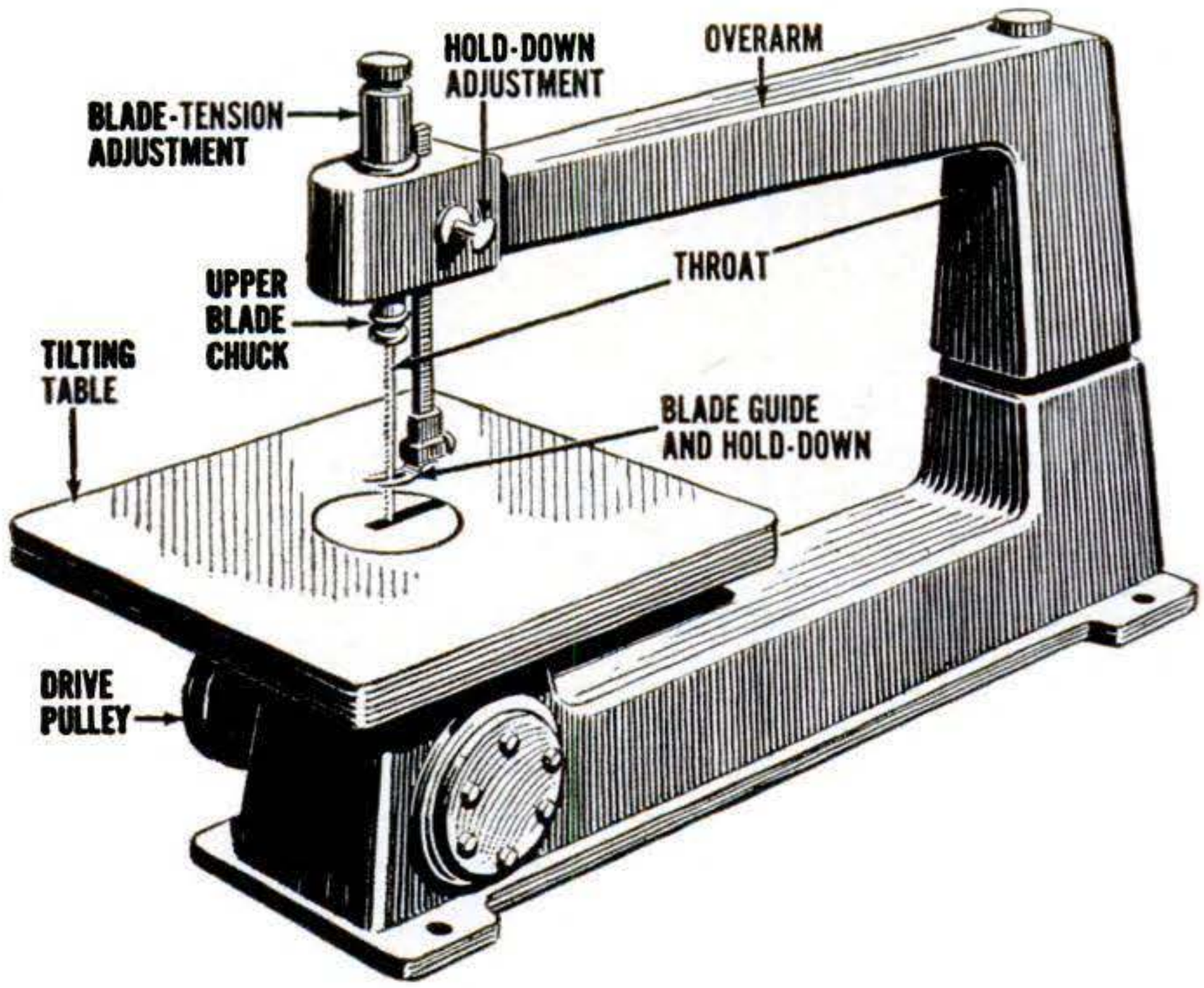


20-tooth wide: For fairly straight, heavy cuts in nonferrous metals up to ½" thick.

30-tooth: For fine cuts in thin nonferrous metals and semi-hard materials up to 1/16".

32-tooth: For fine cuts in thin metals, both ferrous and nonferrous, up to 1/16" thick.

JIGSAW *it thrives on fancy, delicate cuts that no other tool can make*



LOOK down a jigsaw's throat—that's the tip-off to a healthy cutting capacity. A jigsaw makes the finest cuts of any power tool, but it has one necessary blind spot—the overarm supporting the blade also limits work size. Unless your jobs are mainly small, look for a saw with good throat depth.

On some saws, the overarm can be removed for unrestricted cutting with saber blades. This is handy, but is not as important as it used to be since the same jobs can be done with the newer portable saber saw. It's useful, in any case, only for fairly coarse cutting. What's more useful is a blade swivel. This lets you turn the blade at right angles to the overarm so you can rip long stock without bumping into it.

While you don't expect a jigsaw to cut heavy timbers, it should have at least enough depth-of-cut capacity to handle an occasional two-by-four, flat. The table should tilt for bevel cuts and should provide good work-support area. Some means of changing blade speed is important so you can make fast, smooth cuts in wood, then throttle down for metals and plastics. Some saws provide for a range of speeds, as shown in the chart. On others, it will be necessary to rig up your own cone-pulley speed changer. Be sure, in this case, that the saw spindle can take a cone pulley.

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Quick Facts About JIGSAWS

MAKE	MODEL	DEPTH OF THROAT (in.)	DEPTH OF CUT (in.)	TABLE SIZE (in.)	CUTTING STROKES PER MINUTE	HAS REMOVABLE OVERARM	TYPE OF BEARINGS	MIN MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
BOICE-CRANE	2208	24	4	20x20	1,100	no	ball	⅓-½	$298
DELTA-ROCKWELL	40-100	16	2	11x11	800-1,275	no	ball	⅓	$58
DEWALT	530	24	2¼	14x14	570-1,660	yes	ball	⅓	$120
DREMEL	560	8	1¾	7x7	3,450	no	sleeve	*	$25*
	571	15	1¾	8x8	3,450	no	ball	*	$34*
DURO	E3000	12½	3	9x9	540	no	sleeve	⅓	$33
	D3003	16	3	11x11	540	no	sleeve	⅓	$39
MONTGOMERY WARD	84C2392M	12½	1½	9x9	2,392	yes	sleeve	¼	$28
POWERMATIC	950-01	24	1¾	14x15	610-1,255	yes	ball	⅓	$115
SEARS CRAFTSMAN	99G207ZN	18	2	12x12	875	yes	sleeve	⅓	$48
SHOPMASTER	J-20	20	2½	10x12	1,670	no	sleeve	*	$65*
	J-2000	20	2½	10x12	1,330	no	sleeve	¼	$55
TOOLKRAFT	215	15	2	10x11	1,270	no	sleeve	¼	$37
	218B	18	2⅛	12x12	1,270	yes	sleeve	⅓	$60

*Includes built-in motor.

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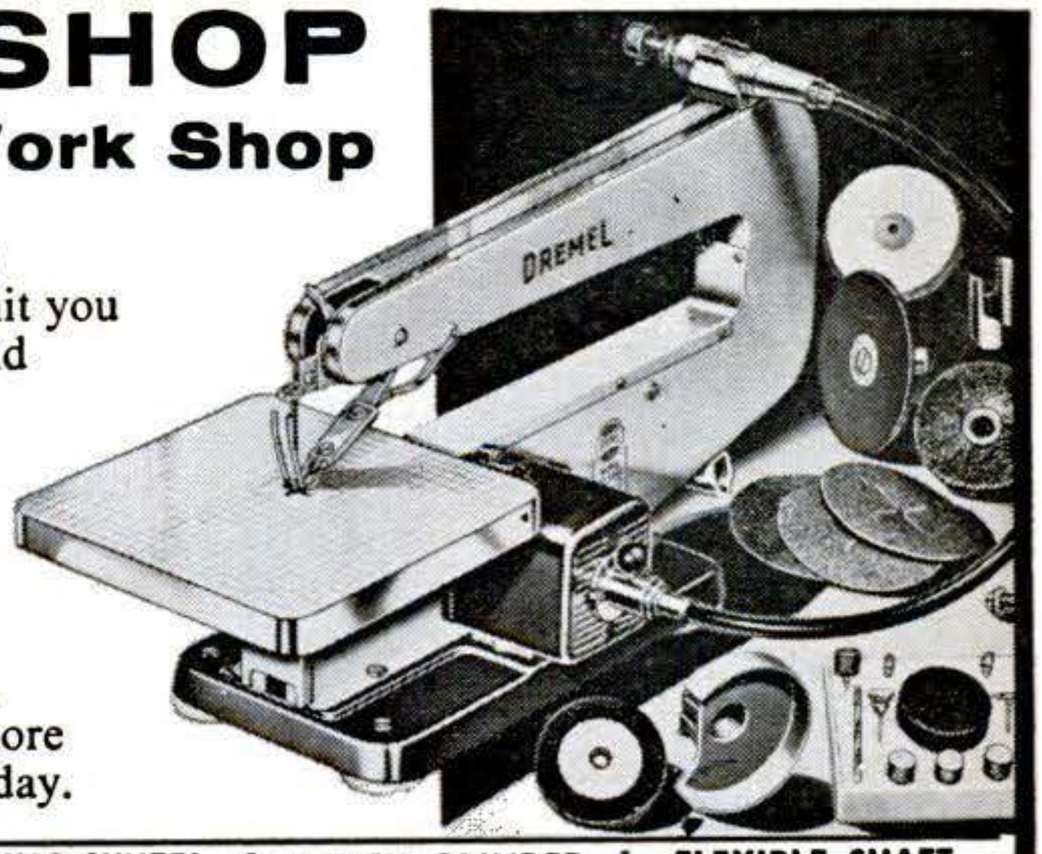

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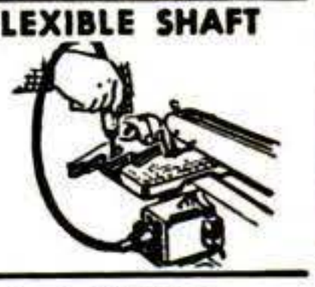

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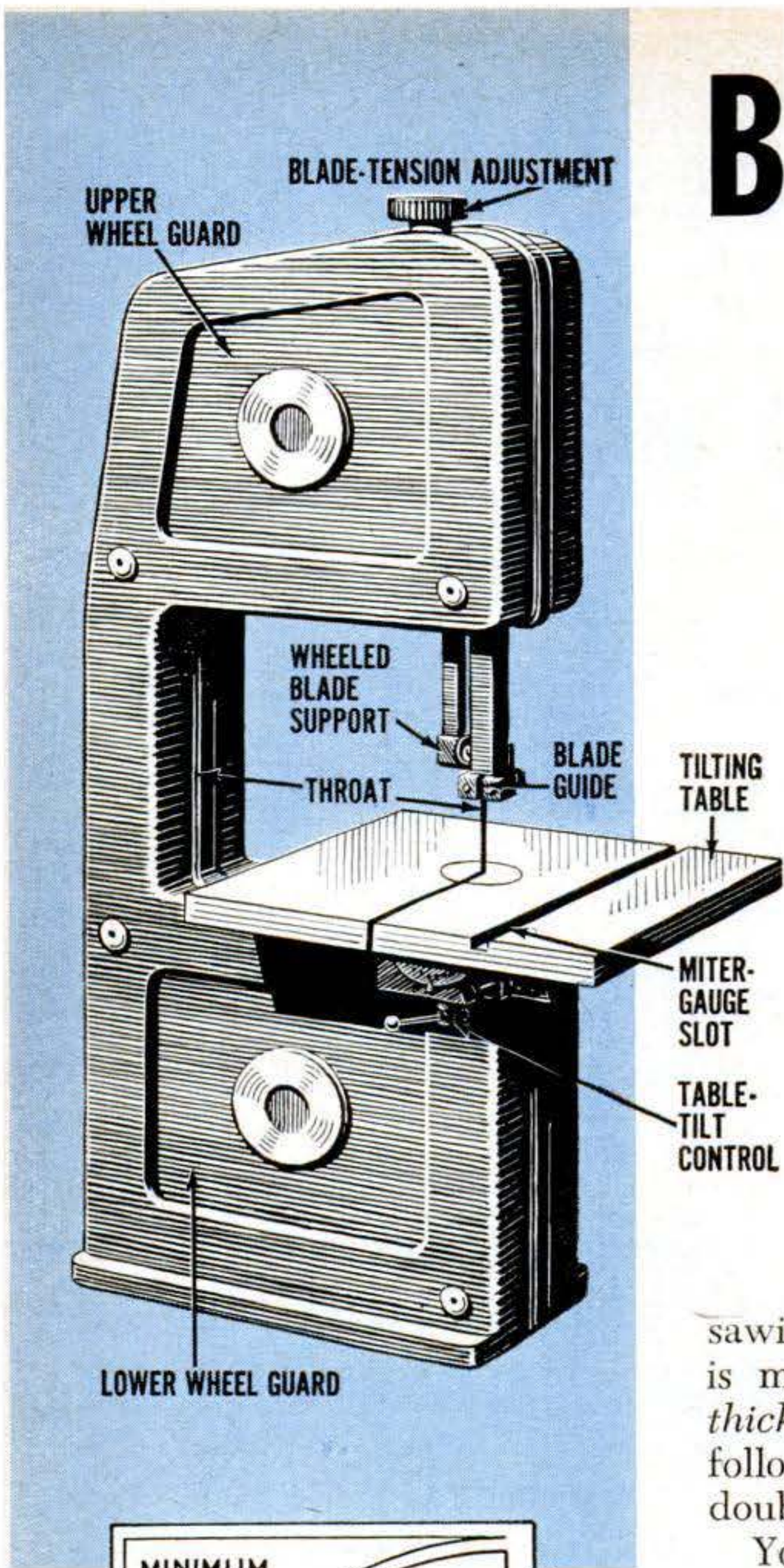
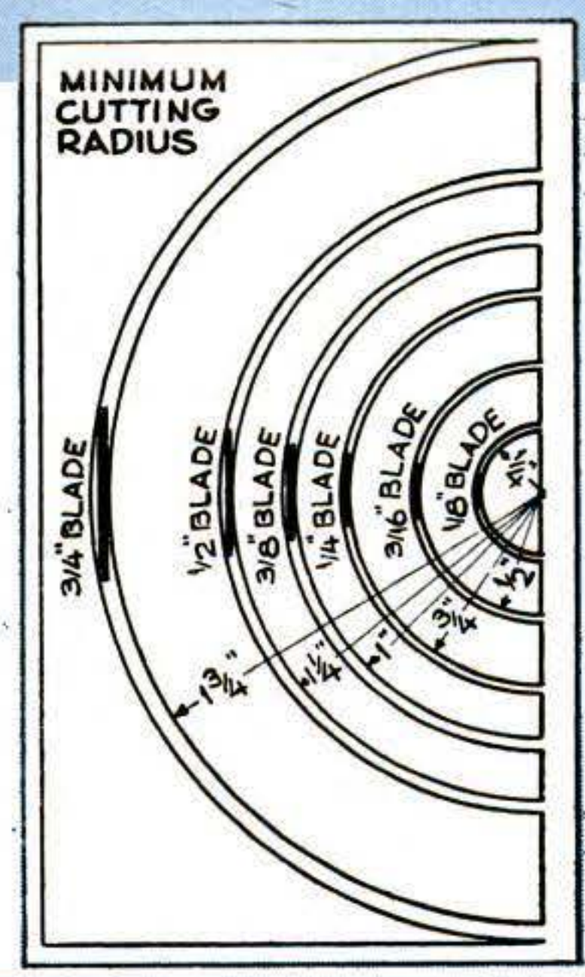
BANDSAW

top choice for rugged contouring





How blade width affects the curves you can cut

The narrower the blade, the sharper it can turn. Choose wide blades for straight cuts, narrow ones for scrollwork.

THE bandsaw is the jigsaw's big brother. But while it looks and works much like a jigsaw, it's actually designed for quite different uses. It will carve out a half-foot-thick stack of identical boat ribs or slice a one-by-six plank in half on *edge*—jobs you'd never touch with a jigsaw. It's not as fine-cutting as the jigsaw, but what it lacks in delicacy it makes up for in ruggedness.

Unlike the jigsaw, the bandsaw uses a continuous-loop blade running between two (sometimes three) pulley wheels. As on a jigsaw, the width of stock you can cut is determined by the saw's throat depth—the clearance between the blade and the column. While good throat depth is desirable, it's not as critical on a bandsaw because you're more likely to be sawing thick, narrow stock than wide, thin stuff. What is more important is cutting capacity—the maximum *thickness* you can saw. This varies, as the chart on the following page shows, all the way from 4″ up to nearly double that amount.

Your choice of blade width depends on the kind of cutting you do most often. Narrow blades cut sharper curves; wide blades are more accurate on straight cuts. The smaller bandsaws take blades up to ⅜″ wide; bigger machines go up to ½″ or ¾″. Wide-blade capacity is important mainly if you plan to do a lot of straight ripping or resawing. The chart shows the range of blade widths available for each model.

Woodworking bandsaws run at about 2,000 to 3,000 blade feet per minute. If you want to cut metal, you'll need to slow this way down. Nonferrous metals require 250 to 350 f.p.m., iron and steel 75 to 150 f.p.m. Slow-speed attachments are available for some models. On others, you'll have to add your own speed-reducing pulleys—a point worth checking. Be sure, too, that metal-cutting blades are made for your machine.

A good-size table is important since you're likely to be working with bulky stock. It should tilt for bevel cuts and have a miter gauge so you can make square and miter cuts accurately. A rip fence is important, too, but not all saws have one. Some have table holes for an accessory fence. On others, you'll have to drill the table yourself or resort to clamped-on guides. If ripping is your meat, insist on a fence.

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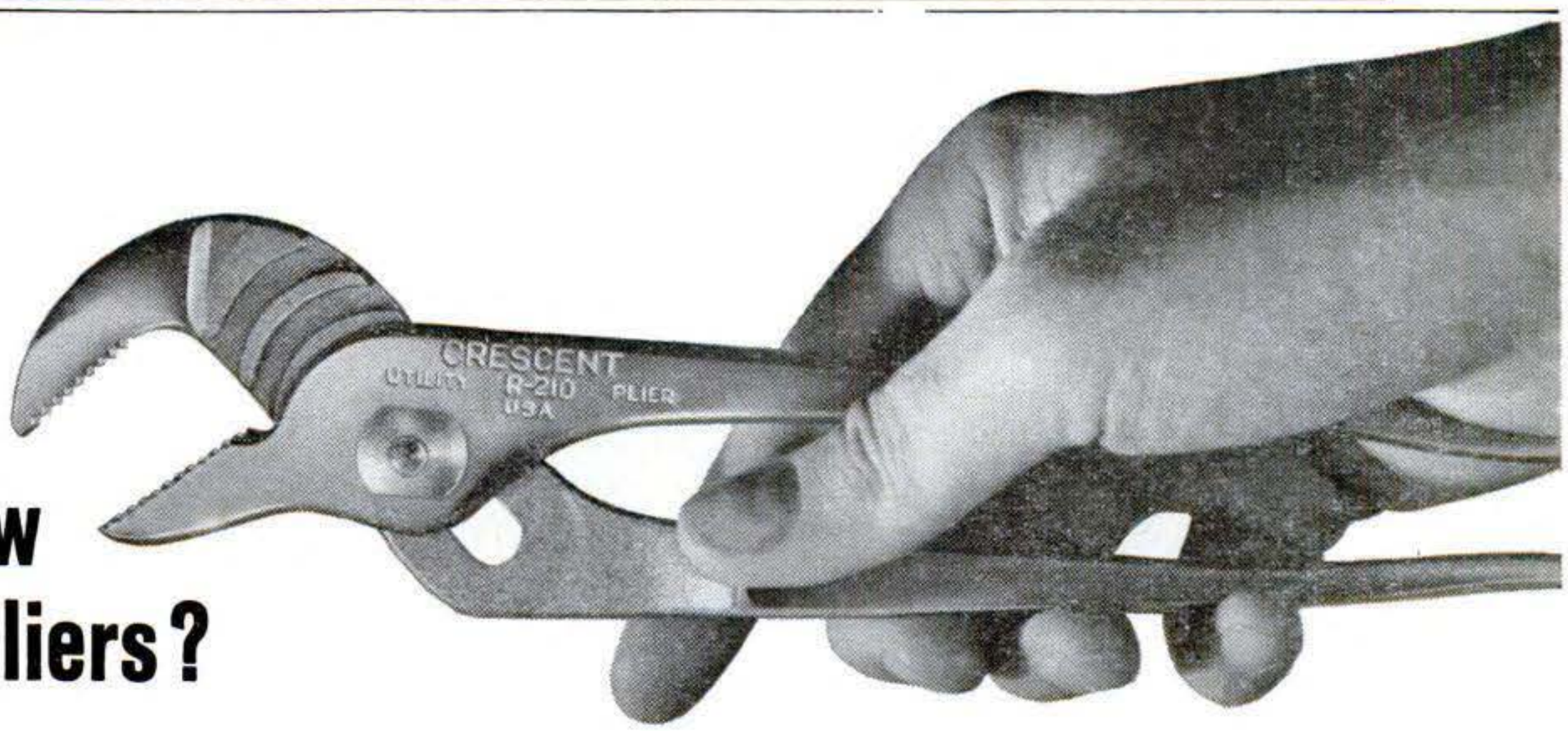
Quick Facts About BANDSAWS

MAKE	MODEL	DEPTH OF THROAT (in.)	CAPACITY OF CUT (in.)	BLADE SPEED (ft./min.)	BLADE WIDTHS AVAIL. (in.)	BLADE LENGTH (in.)	TABLE SIZE (in.)	TYPE OF BEARINGS	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
BOICE-CRANE	2300	13½	7¾	4,100	3/16-¾	98	15x15½	ball and needle	½	$220
	2304	13½	7¾	4,100	3/16-¾	98	15x15½	ball and needle	½-¾	$230
COMET	14-63	14	6¼	4,400	⅛-½	77	16x16	ball	½	$279
DELTA-ROCKWELL	28-100	9⅝	6¼	2,400	⅛-⅜	71¾	10x11	ball	⅓	$80
DEWALT	440	12	6¼	2,052	⅛-½	83	14x14	ball	½	$145
DURO	A3027	10¼	4⅝	2,350	⅛-⅜	68	10x10½	needle	⅓	$100
	K3021	12	5⅛	2,110	⅛-⅜	78	13x13	needle	⅓	$143
MONTGOMERY WARD	84C2325MO	9	4	2,000	⅛-⅜	60	10x10	ball	⅓	$55
	84C2328F	14	6½	2,600	⅛-½	94	14x14	ball	⅓-½	$117
POWERMATIC	141-01	14	6½	3,000	⅛-¾	96	15x15	ball	⅓-½	$153
	143-02	14	6½	40-3,000*	⅛-¾	96	15x15	ball	½-¾	$280
SEARS CRAFTSMAN	99G2455L**	12	4	2,064	¼-⅜	62	12x12	ball	⅓	$63
	99G2426L	12	6	2,165	⅛-½	80	12½x14½	ball	⅓	$98
SHOPMASTER	SB-1400	10	5	2,140	⅛-½	63	11x11	roller	¼	$80
TOOLKRAFT	385C	9½	4½	4,060	⅛-½	60	11x10	ball and sleeve	¼	$75

*Continuously variable. **Three-wheel design.



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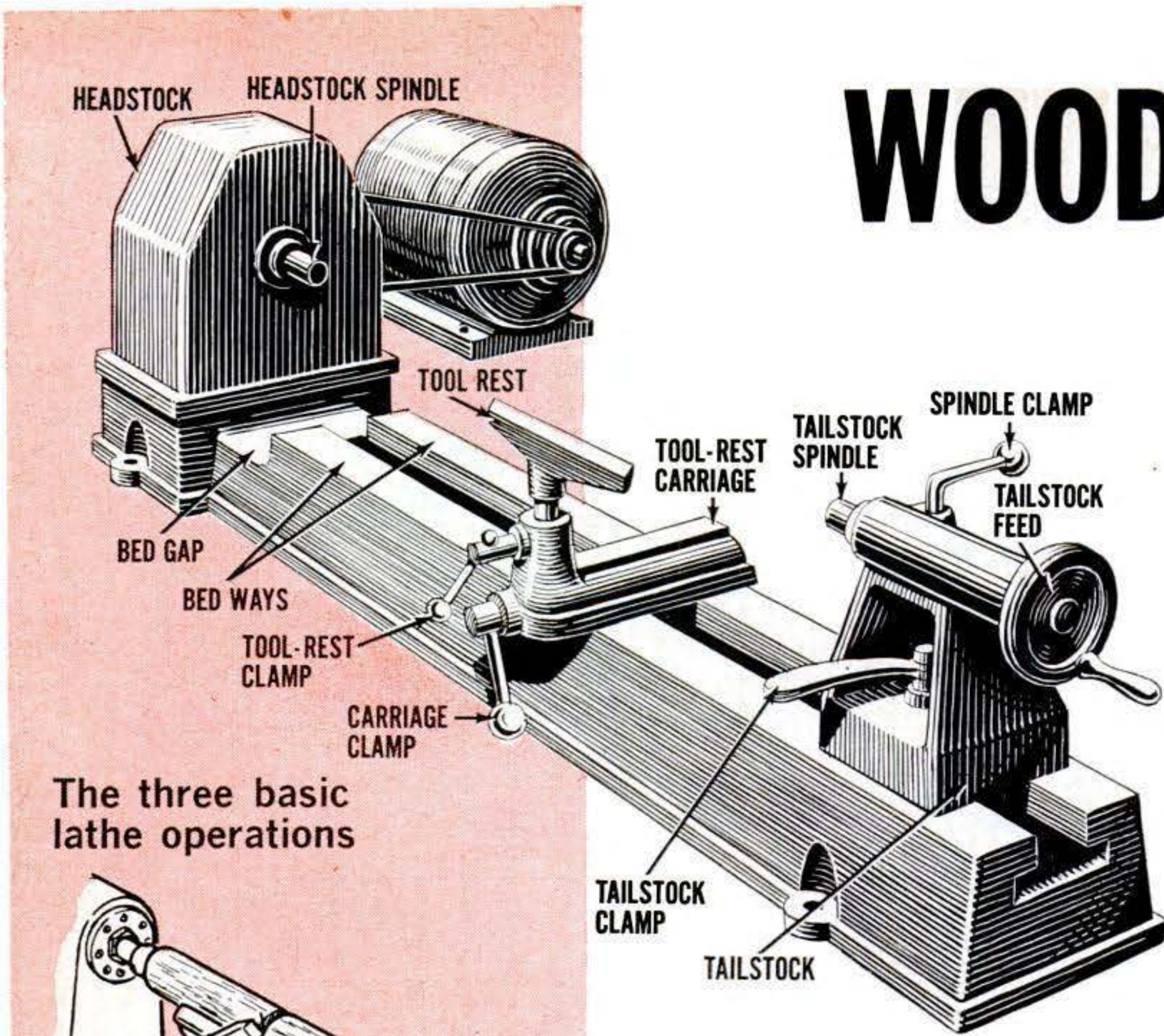
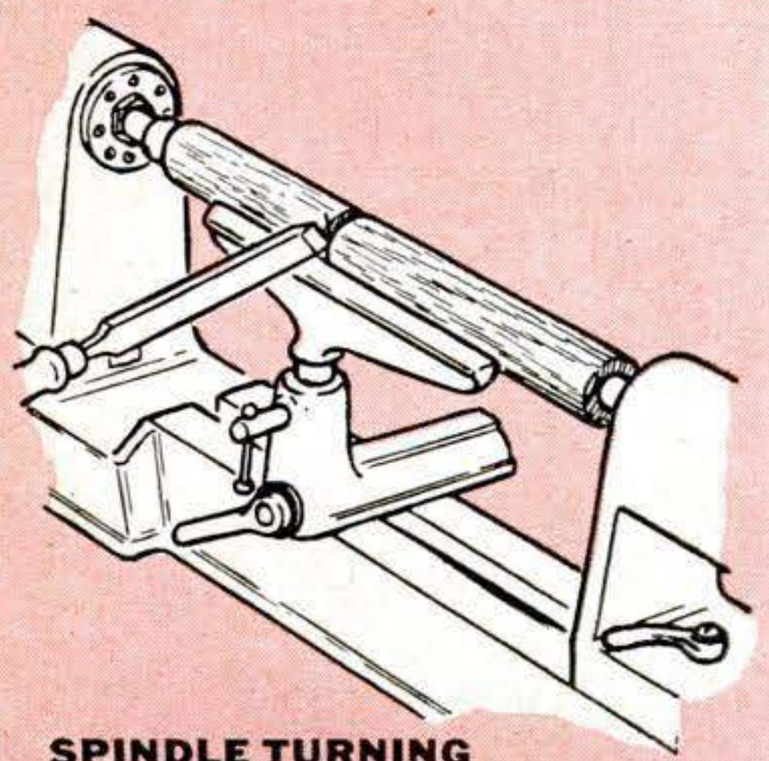
WOOD LATHE

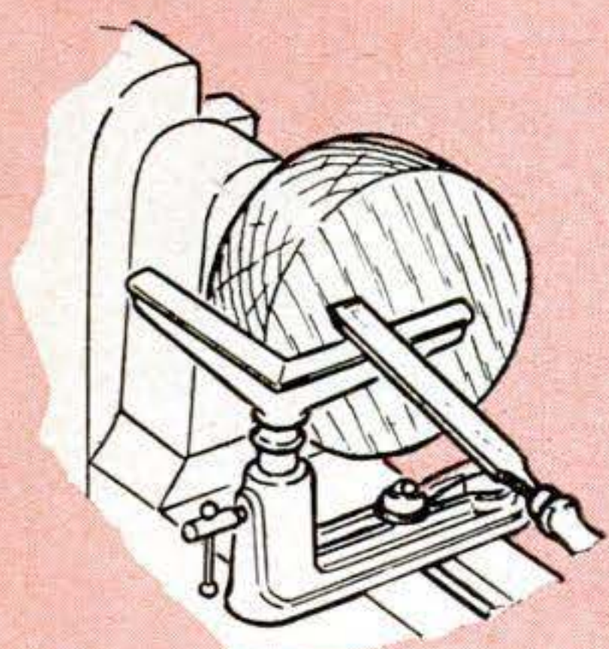
a whole new world of home-shop skills



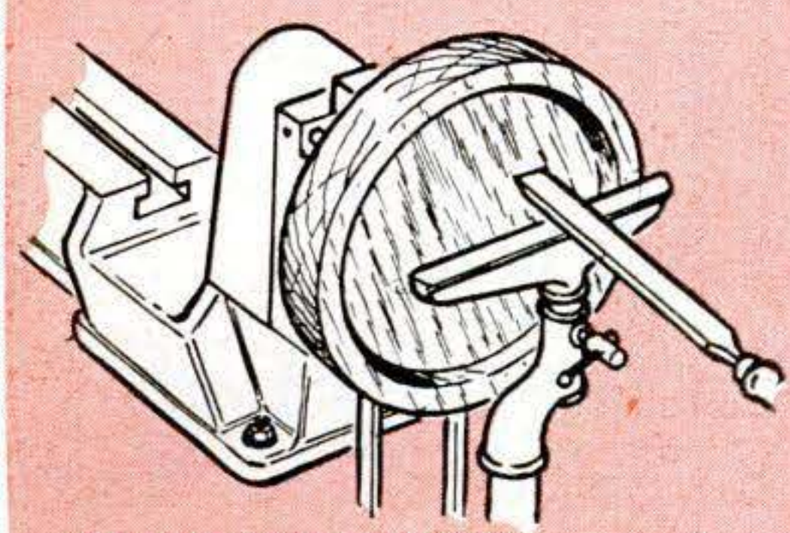
The three basic lathe operations



SPINDLE TURNING



FACEPLATE TURNING



OUTBOARD TURNING

YOU have a thrill coming the first time you use a wood lathe. Seeing a spinning billet take shape under your hands opens a new world of craftsmanship. Starting with simple legs and spindles, you can graduate to inlaid, oval, and astonishing spiral work. You can also turn plastics and soft metals.

In addition to end-drilling and deep boring, you can squeeze other jobs from a wood lathe. The spindle will take wire brushes, buffing pads, and grinding wheels. One model listed here has a wheel permanently mounted inside the head guard, where it's shielded. With a sanding plate and a homemade table, you have a disk sander. A turned cylinder covered with abrasive paper becomes a drum sander. Make an adjustable table to go under it, and it's a thickness sander.

In choosing a lathe, look for adequate capacity first. The swing (diameter of work that will clear the bed) and center-to-center distance must be great enough for the largest work you want to handle. Two dodges, however, provide extra swing for large faceplate turnings. One is a depression or gap in the lathe bed in front of the headstock, found on some models. The other is outboard turning. On some lathes the faceplate can be mounted on the left, or outboard, end of the spindle, where there is no bed to limit swing. A pedestal is usually required to support the tool rest.

After capacity, look for a rigid bed and good, well-fitted bearings in which the spindle turns with no shake or play, either sideways or endwise. Other features to check for are a smoothly working tailstock ram and a husky, easily adjusted tool rest.

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Quick Facts About WOOD LATHES

MAKE	MODEL	SWING OVER BED (in.)	CENTER-TO-CENTER LENGTH (in.)	RAM TRAVEL (in.)	RANGE OF SPEEDS (r.p.m.)	TYPE OF BEARINGS	PERMITS OUTBOARD TURNING	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
AMERICAN MACHINE & TOOL	214W	6	23	3	900-2,000	sleeve	no	1/3	$10
BOICE-CRANE	3702	12	42	2 1/4	930-3,300	ball	yes	1/2-3/4	$160
DELTA-ROCKWELL	46-111	11	36	2 3/16	990-3,250	ball	yes	1/3	$95
DEWALT	730	12	36	2 1/8	635-4,680	ball	yes	1/2	$155
DURO	B3052	8	27	1 1/2	750-3,900	ball & sleeve	no	1/3	$33
	K3053	10	31	1	750-3,800	ball & sleeve	yes	1/3	$75
MILLERS FALLS	2180	8	30	1 3/8	900-3,200	sleeve	yes	1/3	$35
MONTGOMERY WARD	84C2020MO	9	30	1 1/2	800-3,800	ball	no	1/3	$54
	3225	16 1/2	28	3**	1,700-6,400	ball	no***	3/4	$249*
POWERMATIC	4500-01	12	39	4	915-3,260	ball	yes	1/2	$204
SEARS CRAFTSMAN	99G2162L	8	31	1 1/2	1,025-2,985	ball & sleeve	no	1/3-1/2	$38
	99G2388N	12	37	1 3/8	875-3,450	ball	no	1/3	$56
SHOPSMITH (Magna-American)	MARK 5	16 1/2	34	4 1/4**	700-5,200	ball	no***	1 1/8*	$320*
	MARK 7	16 1/2	34	4 1/4**	700-5,200	ball	no***	1 1/8*	$370*
TOOLKRAFT	390A	10	37	2 1/8	700-4,250	ball	yes	1/3	$85

*Multipurpose tool with built-in motor.
**Not a true ram, but provides similar action through quill feed on headstock.
***Large swing provides similar turning capacity.

Quick Facts About METAL LATHES

MAKE	MODEL	SWING OVER BED (in.)	SWING OVER CARRIAGE (in.)	CENTER-TO-CENTER LENGTH (in.)	RAM TRAVEL (in.)	COMPOUND-REST TRAVEL (in.)	TAILSTOCK SETOVER (in.)	CROSS-SLIDE TRAVEL (in.)	RANGE OF SPEEDS (r.p.m.)	RANGE OF FEEDS (in.)	THREAD RANGE	SPINDLE BEARINGS	SPINDLE BORE (in.)	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
AMERICAN-EDELSTAAL	UNIMAT	3	1 6/10	6 9/10	3/4	none	none	2	900-7,200	.0008*	15-56*	ball	1/4	1/10**	$140**
ATLAS	618	6	1 7/8	18	1 1/4	1 3/4	9/16	4 3/4	54-3,225	.0078-.0024	8-96	tapered roller	17/32	1/4-1/3	$198
	3980	12 1/4	7 3/4	24***	2 3/4	2 1/4	3/4	6 1/2	28-2,072	.250-.0042	4-240 quick-change	tapered roller	25/32	1/2-3/4	$485
DELTA-ROCKWELL	25-700	10 1/8	6	24 1/2***	2 1/2	2	11/16	6	50-1,500	.0810-.0014	4-224 quick-change	ball	15/16	3/4	$680
LOGAN	9B17-61	9 1/4	9	17***	2 3/4	n.a.	1/2	5 1/2	55-1,450	.0156-.0046	4-224	ball	25/32	1/3-1/2	$304
MONTGOMERY WARD	84C2129F	9 1/4	9	17***	2 3/4	n.a.	1/2	5 1/2	55-1,450	.0156-.0046	4-224	ball	25/32	1/3-1/2	$304
SEARS CRAFTSMAN	F99G2128N	6	4	18	1 1/2	1 3/4	9/16	4	120-1,325	.0078-.0024	8-96	sleeve	17/32	1/3	$99
	99G2140N	6	3 1/2	18	1 1/4	1 3/4	9/16	4 3/4	54-3,225	.0078-.0024	8-96	ball	17/32	1/4	$193
	F99G2893N	12 1/4	7 3/4	24***	2 3/4	2 1/4	3/4	6 1/2	20-2,075	.250-.0042	4-240 quick-change	tapered roller	25/32	1/3	$485
SOUTH BEND	9-A	9 1/4	5 1/2	16***	2 1/8	2 1/4	5/8	5 7/8	54-1,200	.0853-.0015	4-224 quick-change	sleeve	3/4	1/2	$499
	9-C	9 1/4	5 1/2	16***	2 1/8	2 1/4	5/8	5 7/8	54-1,200	.0156-.0021	4-160	sleeve	3/4	1/2	$315
	10K-A	10	6 1/4	16***	2 1/8	2 1/4	5/8	5 7/8	52-1,435	.0853-.0015	4-224 quick-change	sleeve	27/32	1/2	$584
	10K-C	10	6 1/4	16***	2 1/8	2 1/4	5/8	5 7/8	52-1,435	.0156-.0021	4-160	sleeve	27/32	1/2	$417

*Optional equipment. **Has built-in motor. ***Longer bed lengths available for same model. n.a.: Not available.

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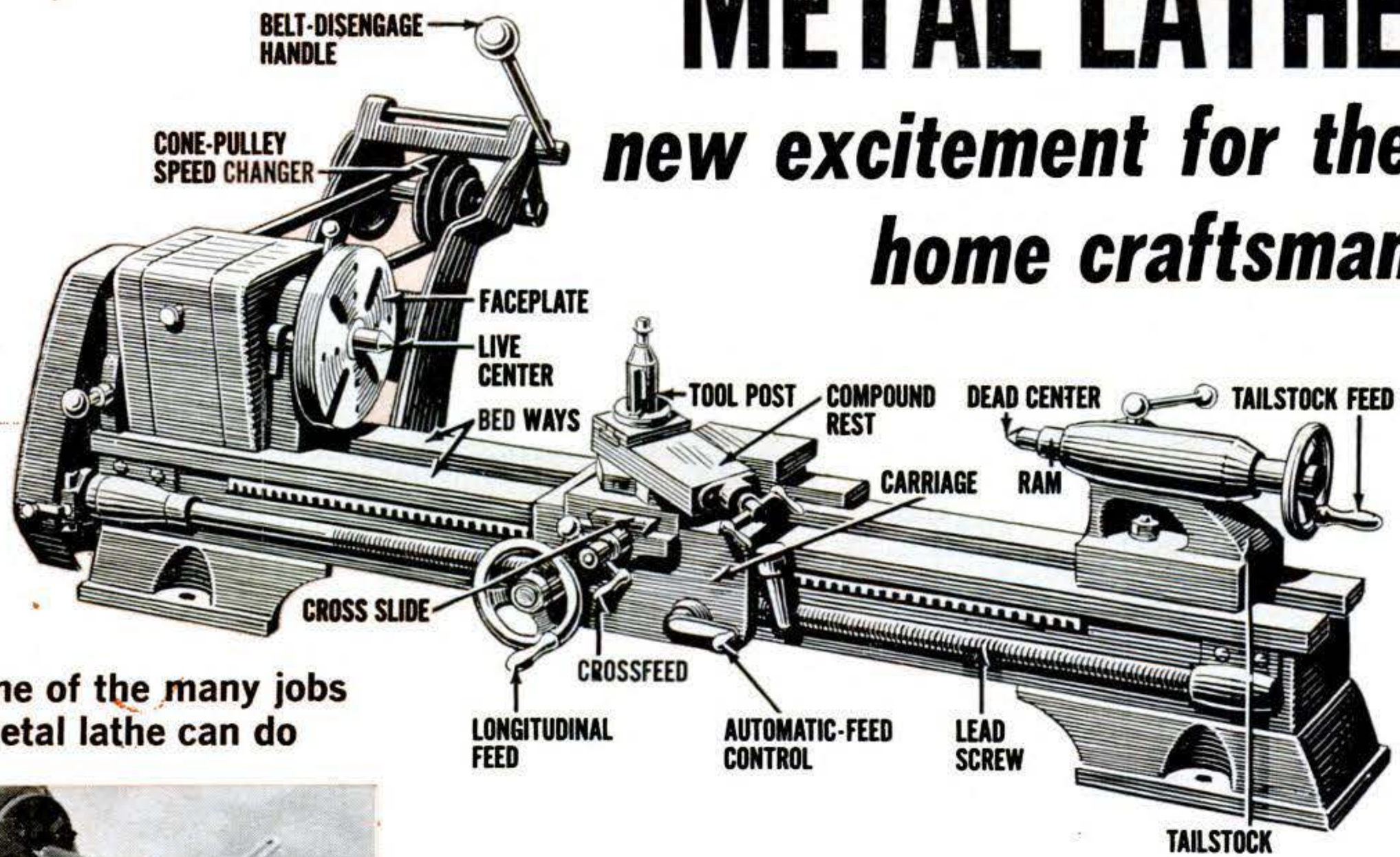
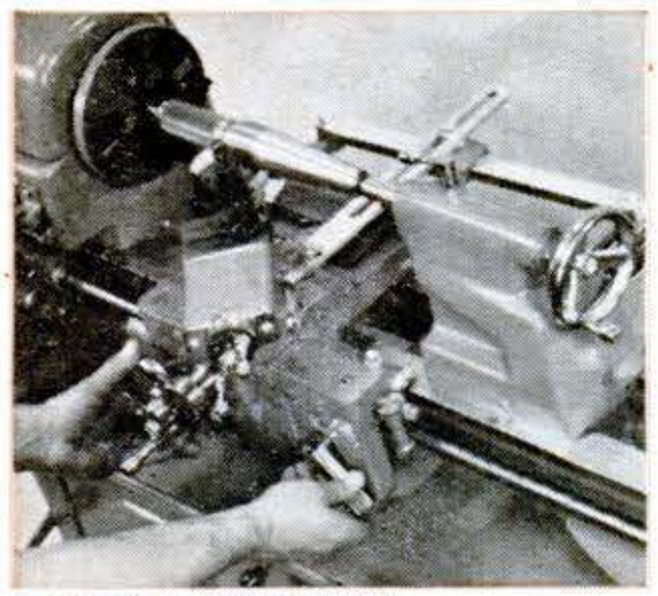
METAL LATHE

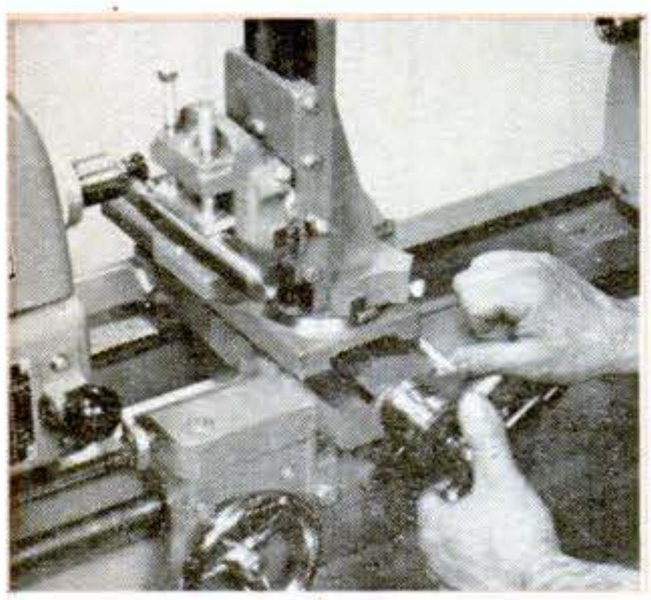
new excitement for the home craftsman



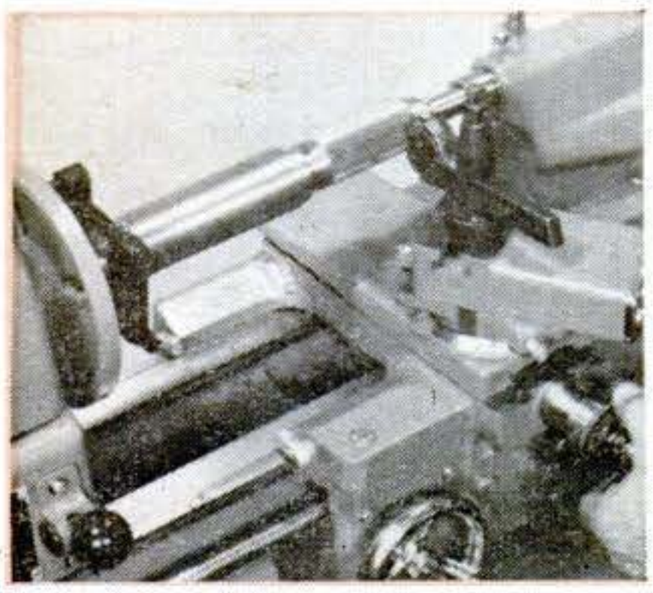
Some of the many jobs a metal lathe can do



TAPER TURNING



MILLING



KNURLING

TURNING metal takes the muscle and guts of a tough machine tool. A metal lathe, which can peel an iron bar like a potato, literally feeds the tool into the work on tracks. King of machine tools, it can also do boring, taper turning, milling, knurling, and drilling, and cut inside or outside threads.

Like the wood lathe, it has a fixed headstock and a movable tailstock. But the ways are machined to close tolerances, and a massive carriage is precision-fitted to slide on them. The carriage has dovetail ways on which a cross slide moves at right angles to the bed. On this is a second set of ways carrying the compound rest, which holds the cutting tool. The compound can be swiveled and locked at any angle. Thus the tool can be fed three ways—along the compound angle, squarely across the ways, or along the bed.

The spindle is geared to a lead screw running along the bed. A split nut in the carriage engages the screw at the touch of a lever. This makes the carriage move a definite distance for each spindle revolution—to feed the tool for turning, or to cut a helix or thread. In some lathes, the crossfeed also is automatic.

Less costly lathes couple spindle and lead screws through a chain of gears that must be interchanged to alter the feed or screw-thread ratio. More costly quick-change lathes have a complex gearbox on which you merely shift levers to choose the ratio wanted.

For the very low speeds necessary to some work, most metal lathes have back gears, a geared countershaft that can be engaged to interpose an extra speed reduction between the pulley and spindle.

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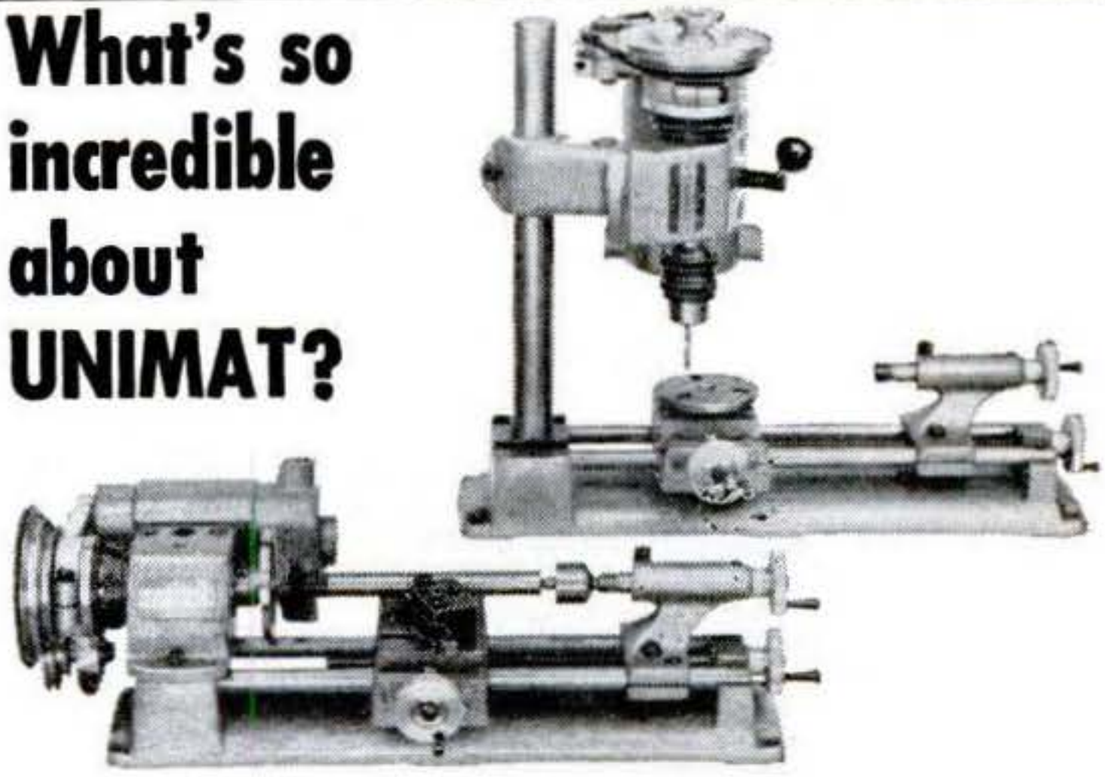

A metal working lathe usually does only one job. Unimat is a fine precision lathe, but it also converts instantly into a dead-accurate precision drill press. The rest of the time, it keeps busy milling metal, boring, threading, surface grinding, sharpening cutting tools and sawing wood.

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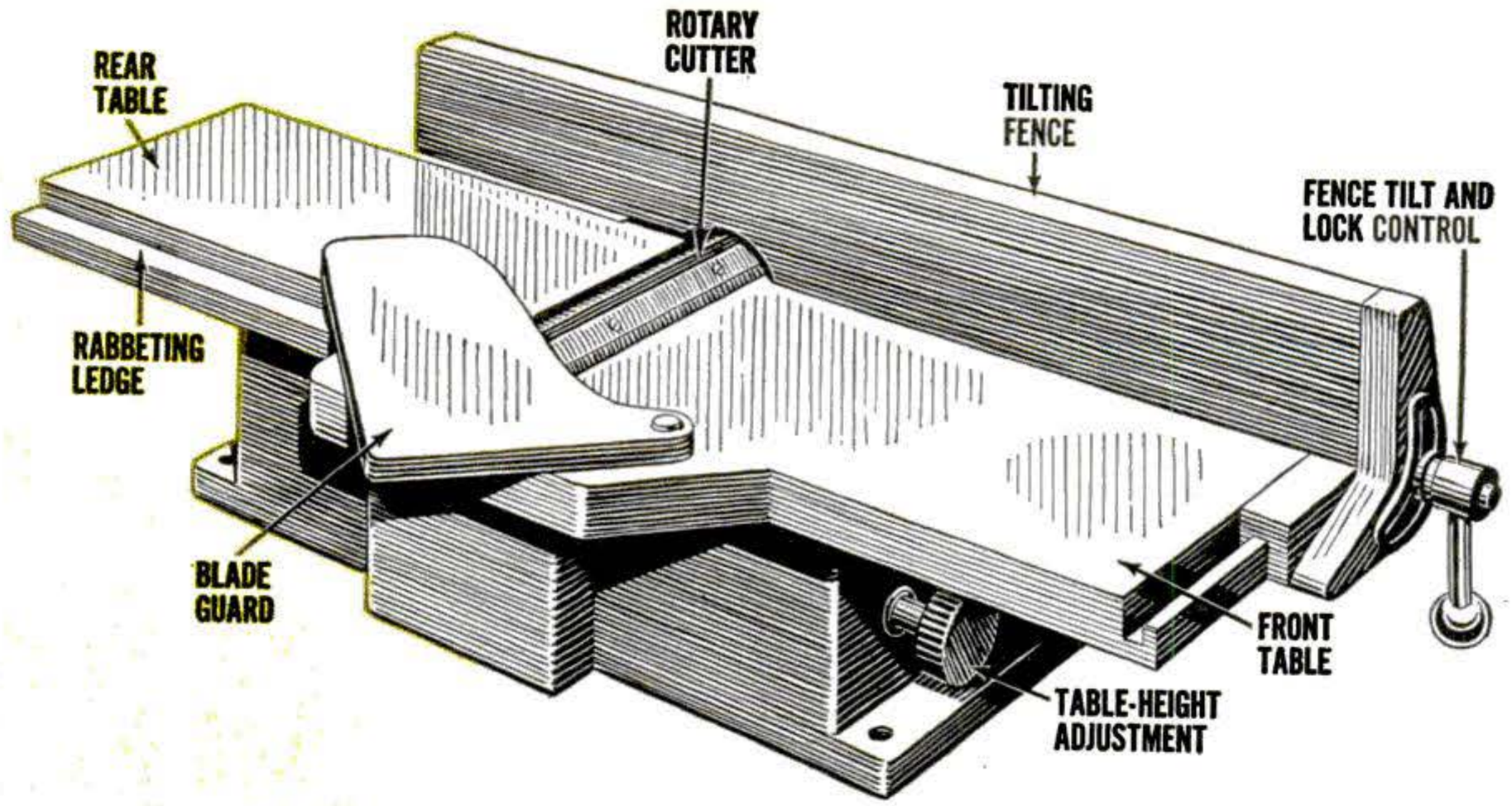
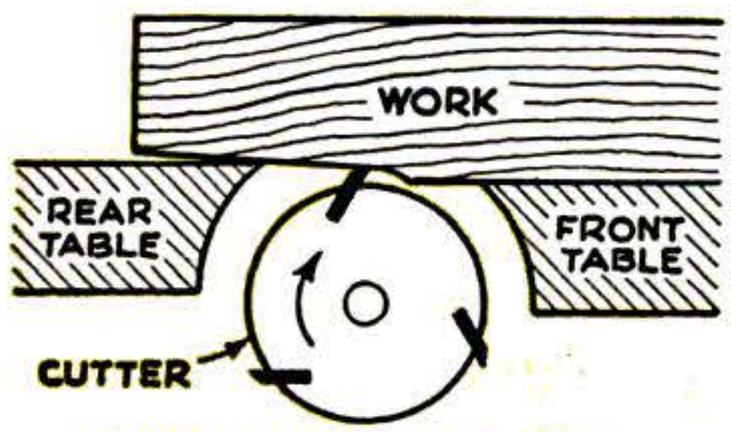
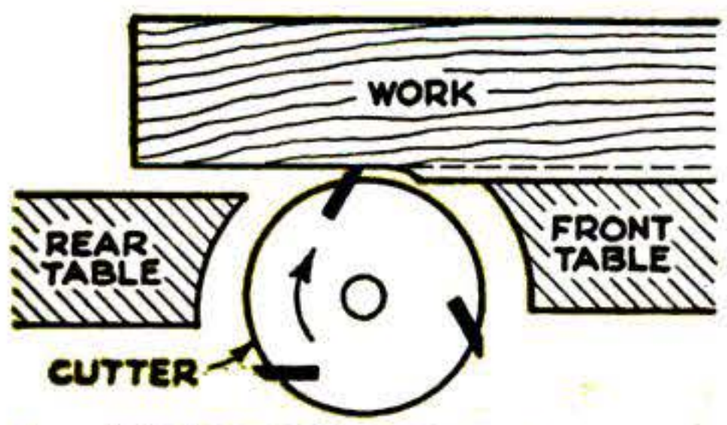


JOINTER-PLANER

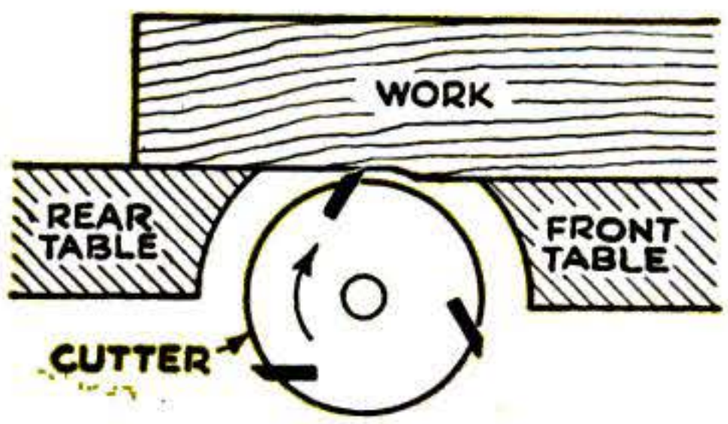
the tool that makes the pieces fit



REAR TABLE TOO HIGH



REAR TABLE TOO LOW



CORRECT HEIGHT

Why table setting is critical: If rear table is high, as at top, work tilts up and cut is tapered. If it's low, as at center, work tips down and is gouged. For accurate cuts, work must rest level on both front and rear tables, as at bottom.

THE jointer-planer is the ultimate tool for precision woodworking. It can square up rough lumber dead true, plane a warped board mirror flat, or shave off an edge in paper-thin bites until a joint fits perfectly. Sanding is seldom required.

The secret lies in a high-speed rotary cutter spinning between two separately adjustable tables—set so the rear table is higher than the front one by an amount equal to the depth of cut. With both the cut and not-yet cut portions of your work always dead level, the whole cut is glass-smooth.

Because the jointer-planer is a precision tool, it's only good if it's good. Table settings must adjust to a fine degree and must hold without wandering. As a rule, the higher the cutting speed and the more cutting blades, the smoother the cut. You'll find ball bearings in all but a few lower-priced machines.

Cutting width indicates the maximum width of lumber you can plane, but even more important is table length. The longer the table, the more support area there is for your work and the greater the accuracy, especially on long stock. Many craftsmen prefer a 6″ machine, not so much because of its greater cutting width, but because it offers more table length than 4″ ones. Fence size is important for the same reason—the longer and higher, the better. Check the chart on page 182 to see how these features compare.

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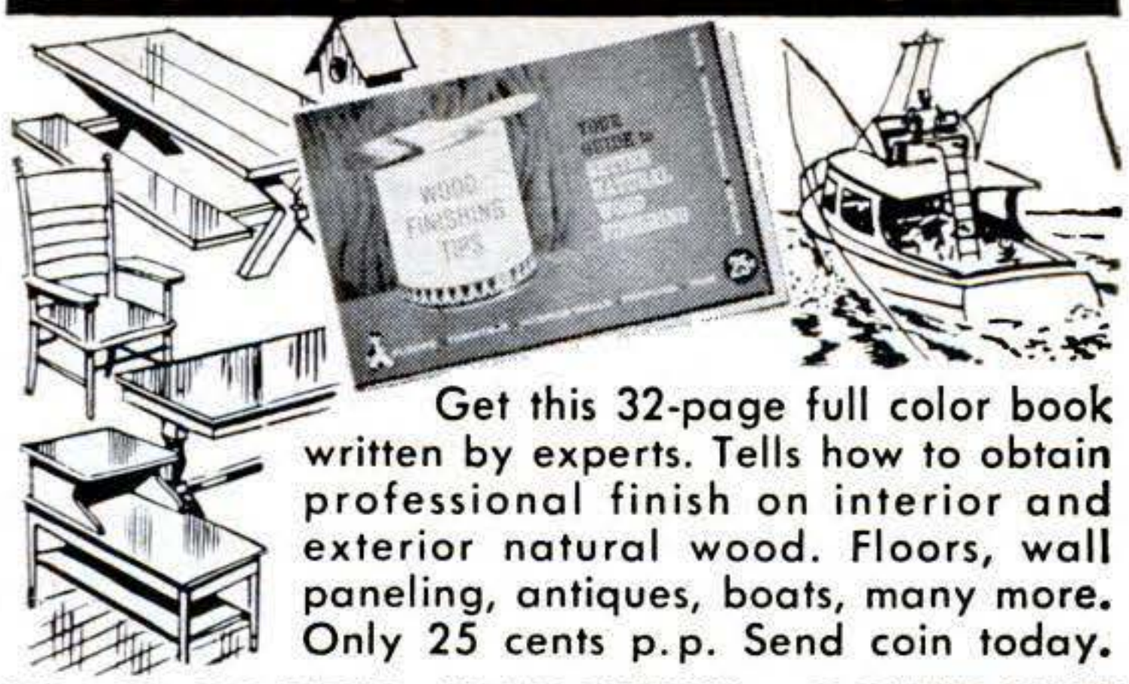
HOW TO FINISH WOOD



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Quick Facts About JOINTER-PLANERS

MAKE	MODEL	WIDTH OF CUT (in.)	RABBET DEPTH (in.)	TABLE LENGTH (in.)	FENCE SIZE (in.)		NO. OF CUTTER KNIVES	TYPE OF BEARINGS	SPEED (r.p.m.)	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
					Length	Height					
AMERICAN MACHINE & TOOL	2431	4 1/8	3/8	22	18	2	2	sleeve	3,800	1/3	$20
	1400	4	3/8	22	17 1/2	2	3	ball	3,800	1/3	$30
BOICE-CRANE	1400A	6	1/2	43 1/2	35	3 3/8	3	ball	3,500-4,500	1/2	$130
	2420	6	9/16	60	48	4	4	ball	4,500	1	$364
	3420	8	9/16	84	66	4	4	ball	4,500	1-1 1/2	$522
COMET	6-62-63	6	1/2	62	30	4	3	ball	3,600	1/2-1	$237
DELTA-ROCKWELL	37-110	4	1/4	24 3/8	20	3	3	ball	4,200	1/3	$55
	37-290	4	1/4	27 1/4	21 1/2	3 1/4	3	ball	4,200	1/3	$75
	37-000	4	1/4	19 1/2	15 1/2	2 1/8	3	ball	4,100	1/2	$80*
DEWALT	230	6	1/2	42	32	4 1/2	4	ball	4,100	1/2-3/4	$140
DURO	F3034	5	5/16	26 1/2	19	2 1/2	3	ball	4,300	1/3	$83
	M3031	6	1/2	26	26	3 7/8	3	ball	4,300	1/2	$143
MONTGOMERY WARD	85C2516MO	4	1/4	19 1/2	15 1/2	2 1/8	3	ball	4,100	1/2	$68*
	84C2514MO	4	3/8	25	18 1/2	2 1/2	3	ball	4,100	1/3	$50
	84C2508R	6	1/2	43	36 1/2	3 1/2	3	ball	4,500-5,000	1/2	$117
POWERMATIC	5000-01	6	1/2	48	34 1/2	4	3	ball	5,000	1/2-1	$178
	6000-01	8	1/2	64	34 1/2	4	3	ball	5,000	3/4-1 1/2	$350
SEARS CRAFTSMAN	99G2186L	4 1/8	3/8	29 7/16	19 1/8	3 1/4	2	sleeve	4,500	1/3	$52
	99G2067N	4 3/8	3/8	31 7/8	26	3 1/4	3	ball	4,500	1/3	$80
	99G2062N	6 1/8	19/32	41 13/16	33	3 1/4	3	ball	4,300	1/2	$120
SHOPMASTER	JO-1500	4	3/8	26	16	3 7/16	3	ball	4,325	1/3	$70
	JO-400	6	1/2	34	20	3 11/16	3	ball	4,325	1/2	$113
TOOLKRAFT	640A	4 1/2	3/8	26 7/8	21	2 3/4	3	ball	4,200	1/3	$75
	650	6	1/2	43 9/16	33 1/2	4 3/4	3	ball	4,200	3/4	$140
	645A	4 1/2	3/8	26 7/8	21	2 3/4	3	ball	4,200	3/4	$105*
	655	6	1/2	43 9/16	33 1/2	4 3/4	3	ball	4,200	3/4	$185*

*Built-in motor.

Quick Facts About SHAPERS

MAKE	MODEL	CUTTER HEIGHT CAPACITY (in.)	SPINDLE DIA. (in.)	SPINDLE TRAVEL (in.)	TABLE SIZE (in.)	FENCE		SPEEDS (r.p.m.)	MIN. MOTOR REQ. (hp.)	APPROX. PRICE (less motor)
						Lgth. (in.)	Ht. (in.)			
AMERICAN MACHINE & TOOL	252	1 1/2	1/2	fixed	none*	10	1 1/2	5,500	1/4	$15
BOICE-CRANE	3125	2 3/16	1	1 15/16	20x27 1/2	27 1/2	2 1/4	7,200	1-3	$297**
COMET	FS-2-63	3 1/2	1	3 1/2	21 1/2x29 1/2	11 1/2	3 1/2	8,000-12,000	1-2	$339**
DELTA-ROCKWELL	43-110	1 1/4 / 2 3/8	5/16 / 1/2	7/8	15 1/2x18	11 1/2	3	9,000	1/2	$95
DURO	D3091	1 5/8	1/2	1	14x18	10	2 1/16	10,000	1/2	$100
MONTGOMERY WARD	84C2475M	3	1/2	7/8	15 1/4x18	11	3 1/8	18,000	1	$79***
	84C2486R	1 1/4 / 2 3/8	5/16 / 1/2	7/8	15 1/2x18	11 1/2	3	9,000	1/2	$84
POWERMATIC	250-01	2 1/2 / 3 1/4	1/2 / 3/4	3	28x29 1/2	12 3/8	3 3/4	7,000-10,000	1-2	$330**
SEARS CRAFTSMAN	99G2394N	2 1/2	1/2	7/8	27x19	21	3	9,000	1/2	$76
SHOPMASTER	SP-800	2 1/2	1/2	1	14x18	10	3	9,000	1/2	$90
SHOPSMITH (Magna-American)	MARK 7****	5 3/8	5/8	4 1/4	14x21	26 1/2	2 3/8	700-5,200	1 1/8	$370***
TOOLKRAFT	250	3	1/2	7/8	18x15 1/4	11	3 1/8	18,000	1	$90***

*Table provided by owner.
**Cabinet model.
***Built-in motor.
****Multipurpose tool.

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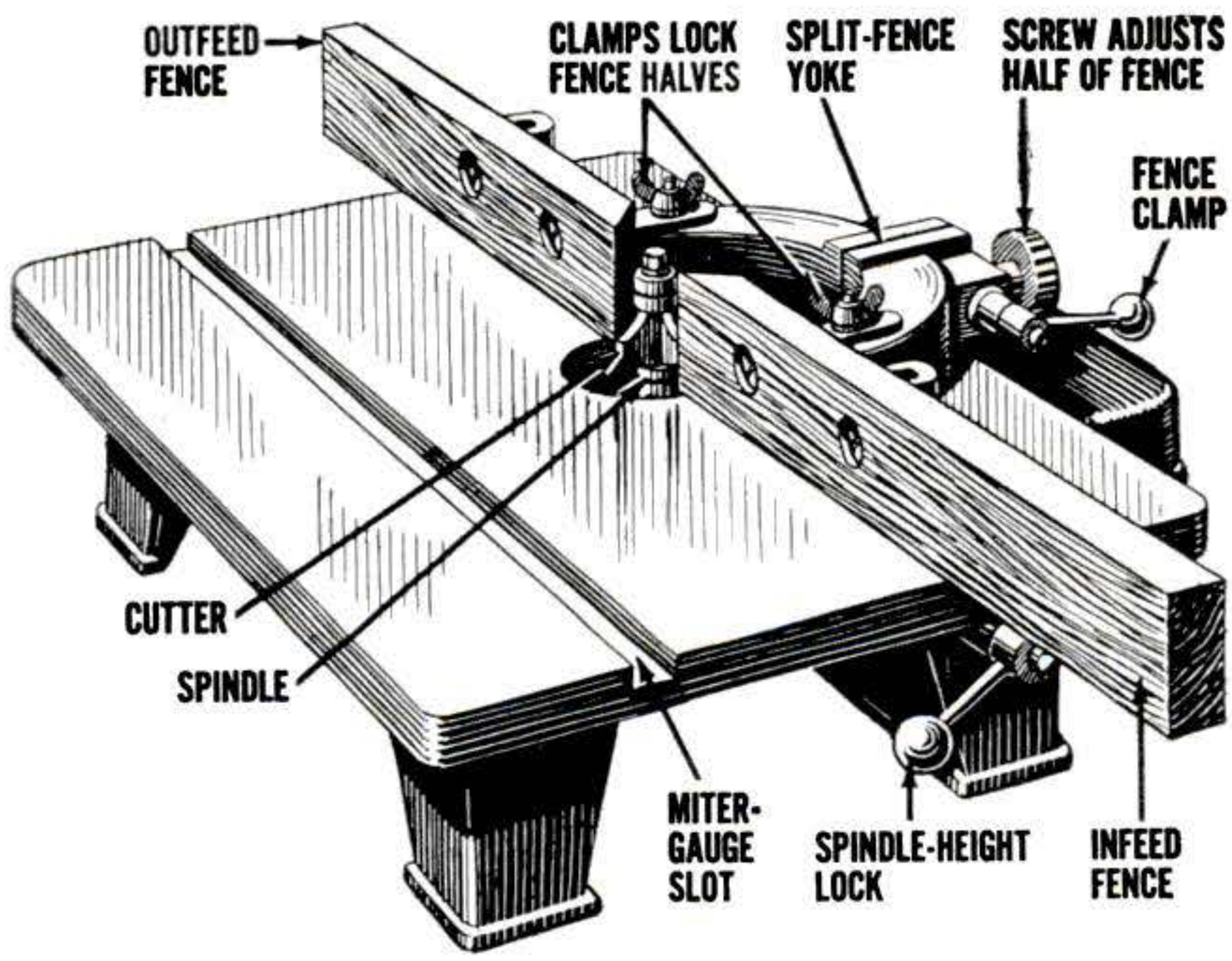
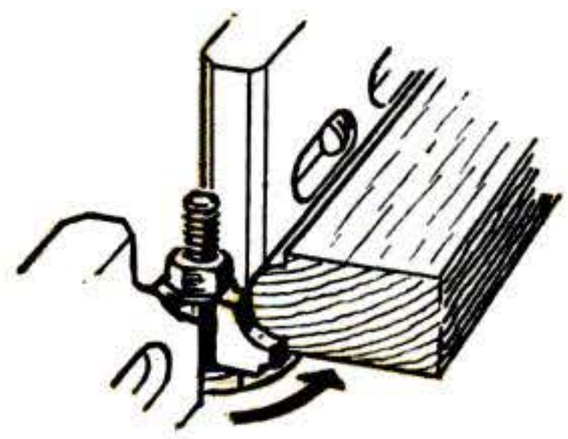




Why a shaper must reverse: To mold lower edge like top one, cutter is turned upside down and work is reversed.

Split fence is needed because outfeed side must often be set ahead of infeed side to support cut-away edge of work.

SHAPER *it gives a professional look to fine woodworking projects*

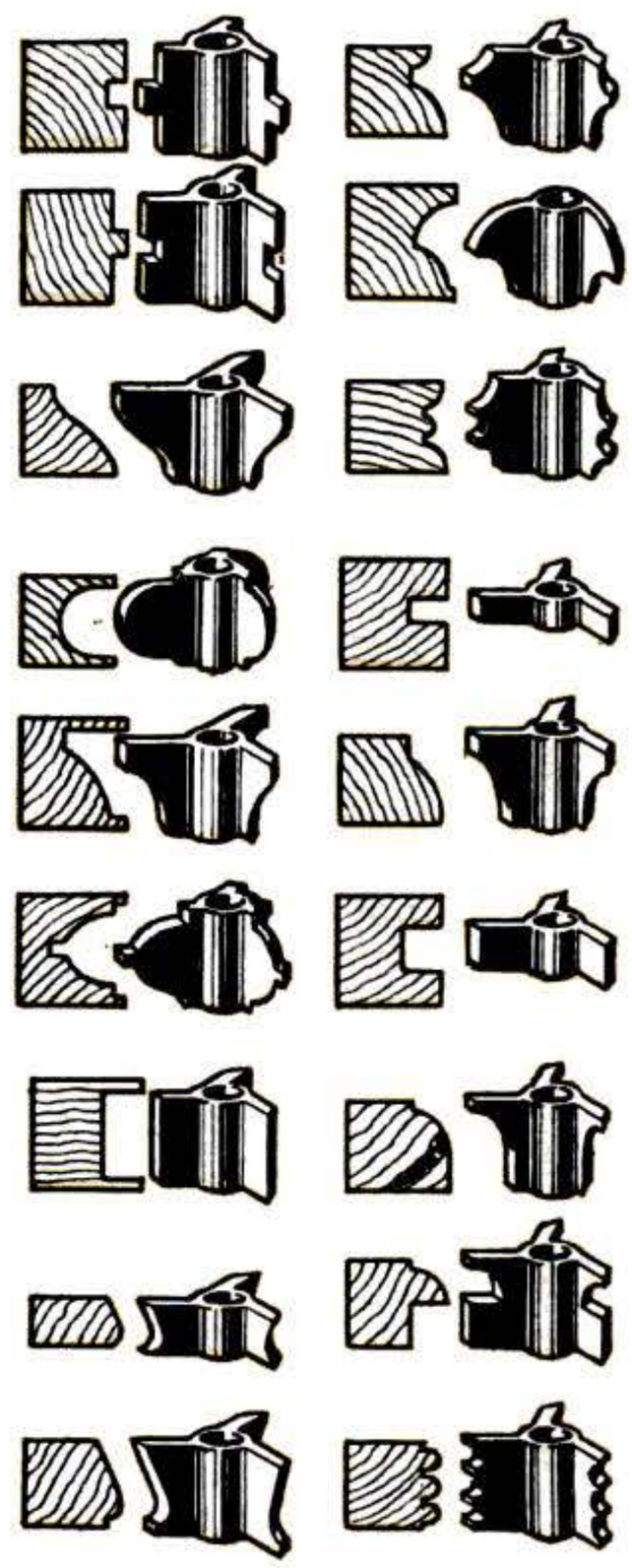
THE shaper is a tool with a magic touch. With equal ease, it will machine-sculpture decorative shapes in wood or do such practical jobs as rabbeting the curved lip on a kitchen-cabinet door.

High speed is a must for smooth shaping. Most machines run at 9,000 to 10,000 r.p.m. or higher. They must be reversible since shaper cuts can be made only *against* cutter rotation. Some cuts require that you reverse the work and feed the opposite way, making it necessary to reverse the cutter as well.

The spindle turns at the center of a two-part split fence. The fence controls the depth of cut and also, to a large extent, the shape of the cut as it determines how much of the cutter's profile engages the work. Both halves of the fence should adjust independently for quick, precise, flexible settings.

The larger the spindle, the larger the cutters it will take—a point to consider mainly for working big stock. Cutter capacity indicates usable spindle length. The greater it is, the more cutters and collars you can stack together to make combination cuts. Spindle travel is the amount the spindle can be raised and lowered—useful in positioning the cutter at exactly the correct height. A good-size table and fence are important for firm work support. All of the machines listed on the chart have ball bearings—a vital necessity.

Some of the many shapes you can make



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Gas-Powered Snow-Trac with 25-m.p.h. Scat
[Continued from page 124]

your crossbars about 8″ apart. It's easy to add the risers to the chain by simply tapping out the regular connecting pins and inserting the riser pins in their place. The crossbars are then bolted to the risers.

Two pairs of bogey wheels are spaced in between the large sprockets to support the crawler track at the middle. These are about 4″ in diameter, can be either small sprockets or smooth-rimmed wheels of the type commonly sold by hardware stores. They serve merely as idler guides and don't have to engage the drive chain. They turn freely on ½″ axles held in the side frames with washers and cotter pins.

Laying out the drive train. Once you have your crawler sprockets and chain, the easiest way to work out the correct axle spacing is to make a full-size mock-up using a piece of scrap lumber. The axles are ¾″ drill-rod steel, so bore one ¾″ hole in the board to represent the front-axle position. Now mount the sprocket and axle in this hole and stretch out the chain to locate the rear-axle position. If the holes in your sprockets aren't exactly ¾″, either ream them out or bush them down to match the ¾″ axles.

Now, using the mock-up as a template, mark the axle locations on the two ¾″-plywood side frames that form the Snow-Trac's backbone. Clamp the frames together and drill all holes through both at the same time to insure accurate alignment. No matter what size sprockets you use, mount them so that the crawler track runs about 1½″ below the edges of the side frames.

All plywood used in the framing should be of exterior or marine grade for good resistance to weathering. The bottom edges of the main side frames are protected from wear by strips of ⅛″-by-¾″ steel strap screwed on to form runners.

Note that you cut oversize holes for the axles and engine jackshaft. These form pockets to hold six ¾″ Fafnir type RA Flangette ball bearings (No. RAO12NPPB). These bearings are inexpensive, yet are rugged and self-aligning so they forgive minor inaccuracies in construction.

Since it's impossible to space the crawler sprockets perfectly, the rear sprocket bearings are held in floating mounts that can be adjusted to put proper tension on the crawler chain after the assembly is complete. These mounts slide in slots in the frame's

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sides to vary the rear axle's position. The crawler chain is pulled up taut by sliding these bearing blocks as far as they'll go toward the rear and lashing them to the frame with shock cord.

Making the crawler. This is a strip of tough neoprene-impregnated nylon available at shops that make awnings and boat covers. Ordinary canvas or industrial belting could be used, but nylon is much stronger and costs only a few dollars.

The nylon runs between ½"-by-1¼" U-channel crossbars, forming a continuous belt. There's no need to stretch the material taut. Leaving it slightly loose creates pockets between the crossbars that give good flotation on top of the snow and resist punctures from sharp objects.

Rigging the steering gear. The ski mounts are made up of telescoping sections of ½" and ¾" pipe that allow each ski to swivel on its own axis, like the wheels of a car. The upper ¾" sections must be reamed out slightly to allow the lower ½" sections to slide freely inside them. The ski supports are connected to the steering column through crank arms and tie rods exactly like car wheels. The ball-bearing tie-rod ends are standard kart parts.

The forward rake of the ski struts is important as it causes the skis to track and caster properly on turns, again like car wheels. The bikelike steering handlebars are bent and welded from pipe or conduit. You can have the whole works—handlebars and ski mounts—stuck together at a local welding shop for a few dollars.

You can experiment with many kinds of skis, even wood ones, but the sheet-metal type shown here is simple and rugged. The V-shaped center ridge can be crimped in with a bending brake at a metal shop. The upward flare at the front of the skis can be bent at any garage that has a hydraulic arbor press. A length of 1" shafting is placed across the skis at the desired point to serve as a fulcrum to bend against.

Coil springs slipped over the telescoping ski struts cushion the skis and give them a knee action. They should be strong enough to support the weight of the machine fully loaded, yet compress enough to let the crawler track make firm contact with the snow. Those shown here are big valve springs available at auto shops.

The skis are also sprung at their fore-and-aft pivot points. The springs here keep

CONTINUED

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forcing the rear ends of the skis downward so the fronts ride up instead of digging into the snow. You can bend them yourself from spring steel or use hay-rake tines, which happen to be perfectly shaped for the purpose and can be bought from farm-equipment dealers.

The axle pivots are ordinary ½″ pipe tees threaded onto the ski struts. To keep them from turning on the threads, align the skis straight ahead and then drill through the tees and the struts for locking pins. Use $\frac{3}{16}$″ roll pins.

Trial assembly. Although it takes a bit more time, you'll find it best to pin everything together temporarily with screws and bolts before applying glue. This gives you a chance to check fits and running clearances before things get critical. When everything is working smoothly, reassemble the parts with waterproof glue.

The curved front cowl could be heavy sheet metal, but we chose plywood for more dent-free rigidity although it's harder to bend. Soak it well on both sides and fasten the lower edge first. Then tie a rope around the upper end and gradually pull it taut to spring the end into place as you drive in the screws, working upward.

Installing the power. The 7.5-hp. Clinton engine mounts just behind the front cowl where it's protected from icy winds and can be reached easily from your seat to make adjustments. For smooth starts and hill-climbing power, you'll need some means of gearing down the engine to about 3:1 to reduce the speed of the track.

We splurged a bit here and selected a No. 500 Salsbury Automatic Torque Converter. This provides a ratio of 3:1 at start-up, then gradually eases up to 1:1 as the machine gains speed. It does this by automatically varying the sizes of the V-belt pulleys on the engine and jackshaft as the load changes. Although it costs about $60, it makes a slick transmission and is well worth the expense.

There are two other less expensive possibilities, however. You can use step pulleys and belt tighteners to change your drive ratios manually. Or you can settle on a fixed pulley ratio of 2:1 and plan to do a little pushing with your feet to get the machine going. A fixed ratio of 3:1 would solve the starting problem but give you modest running speeds.

The drive from the jackshaft down to the crawler axle is by chain and sprocket, both stock kart parts. The small sprocket on the jackshaft is 1½″ in diameter, and the large one on the crawler axle is 7¼″. No. 35 chain runs between them.

For a handy throttle, try a Briggs and Stratton No. 290568 rigged with a length of Bowden wire from a power-mower shop.

Don't pin the crawler sprockets to the axles until you've completed the crawler track. This way, you can slip the track over the sprockets and use it as a guide to get them properly spaced. Unless you're using axles with keyways, simply spot the sprockets at the correct locations and drill through their hubs for locking pins.

You'll need to pipe the engine's exhaust out the rear to get rid of fumes. This is done with a length of 1″ conduit bent to form a tailpipe that runs down under the seat. A standard conduit-to-pipe thread adapter makes it easy to attach the pipe to the engine's exhaust port.

Driving the Snow-Trac is a breeze, but take it easy on sharp turns. Excessive side thrust will shuck the tread off any crawler, so avoid broadside skids.

Where to buy the parts. All of the Snow-Trac's critical parts can be obtained from the following sources:

Fafnir bearings for crawler and jackshaft: Bearings, Inc., 4801 W. Center St., Milwaukee, Wis. Order Flangette type No. RAO12NPPB.

Bogey wheels: Neilson Wheel Co., 1603 N. 27th St., Milwaukee, Wis. Order four No. W 4521 wheels. Same company can also supply chain and sprockets for the jackshaft-to-crawler drive.

Crawler sprockets: 14 tooth, No. 868, available at Sears, Roebuck stores as replacement parts for No. 242.80351 David Bradley elevator. (Has 1″ bore, requiring ¾″ bushing.) Or 17 tooth, No. 8325E for No. 917 David Bradley spreader.

Crawler chain: No. 55 agricultural chain available on order from Sears, Roebuck farm catalogue or Sears stores.

Neoprene-nylon fabric: Allied Canvas Products Co., 725-729 S. 1st. St., Milwaukee, Wis. (about $4).

Hay tines for ski springs: No. R-15080 side rake teeth available from International Harvester dealers.

Salsbury No. 500 torque converter drive: Salsbury Corp., 1010 E. 62nd St., Los Angeles. ■■

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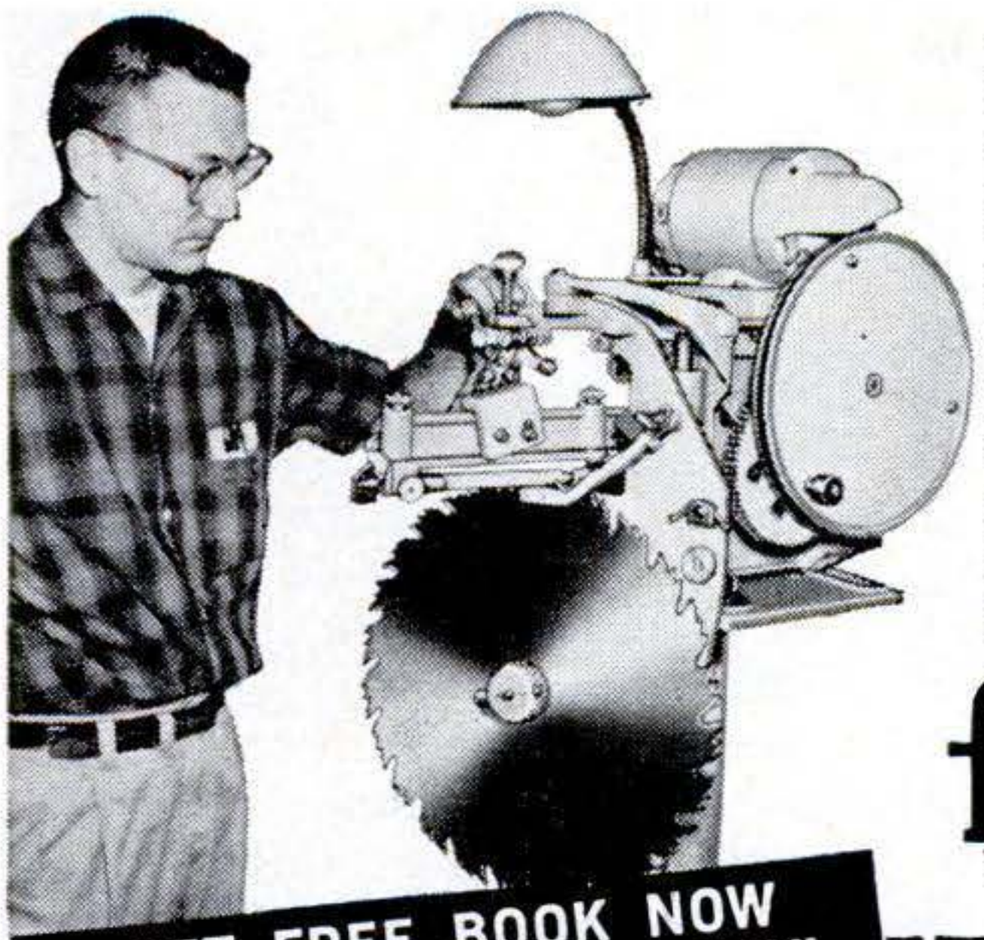

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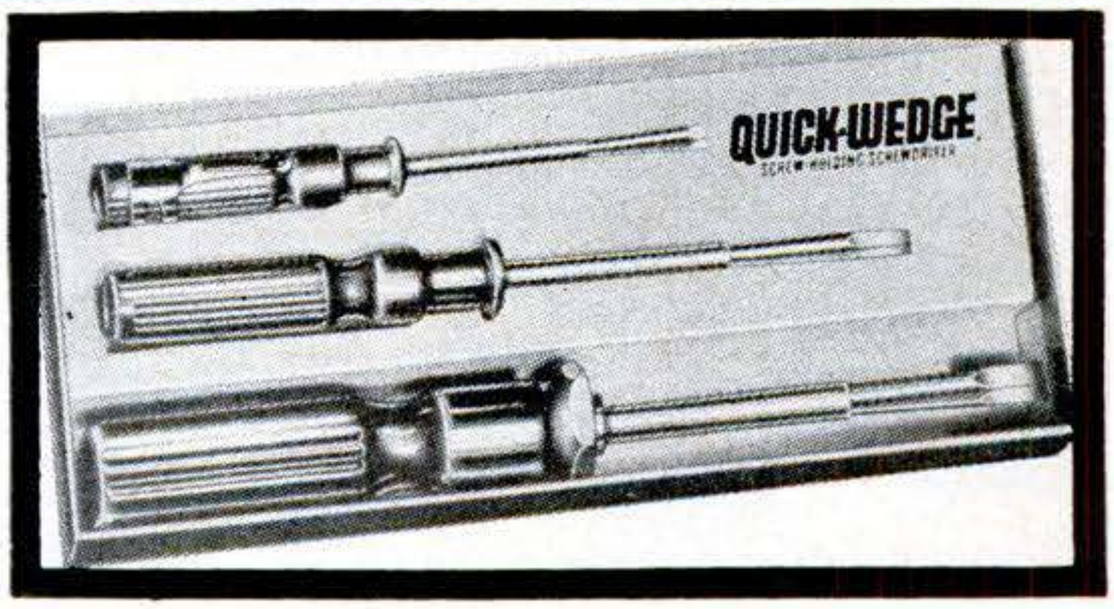

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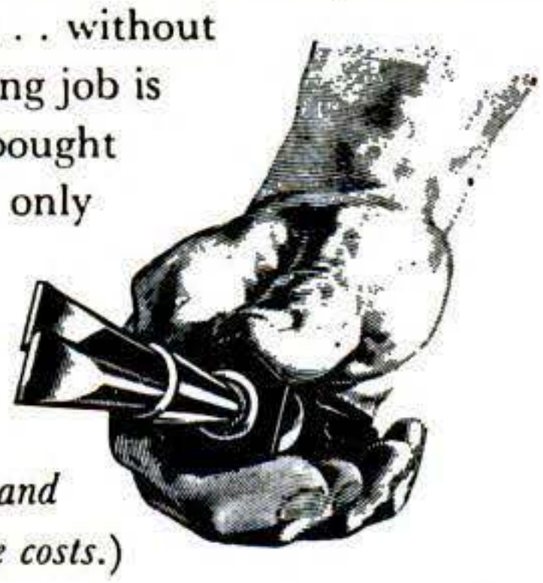

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Must Tomorrow's Man Look Like This?

[Continued from page 80]

row people will demand a way of keeping strontium 90 out in the first place. If we synthesize energizers without side effects so that astronauts can function at peak intellectual and physical efficiency on four hours' sleep a night, every corporation executive in the world will want the prescription. The result will be a biomedical explosion comparable to the electronics explosion of the fifties.

Options? It is really too late to ask "Can man be modified?" He is already. And will continue to be. We are beginning to make successful transplants of major organs. An English doctor is alive today with another doctor's kidney. It's only a question of time before such operations move out of the last-resort category. People will exchange their failing hearts and livers the way we change tires after 30,000 miles. Prosthetic devices, up till now able only to restore some meager part of original function, will become "elective improvement."

How would you like a hand, quite natural looking, just as responsive to your brain as your present hand, but able to twist off the cap of a pickle jar unaided? How would you like to be able to apply a compressive force of several thousand p.s.i., to play six-note chords on the piano, to have fingers with interchangeable screwdriver ends? Nothing to it. The Russians are working on it right now: a "biohand," operated by the owner's own nerves and muscles.

We will be able to modify man. The questions are: "What modifications are desirable?" and "Should we do it at all?" The possibilities and dangers involved will make our present problems seem trivial.

While wishful supporters of the natural man doubt the possibility of lowering oxygen requirements by chemical agents, work has already started on the study of the giant octopus which converts from oxygen metabolism to a system requiring no oxygen at all at extreme ocean depths. If the octopus, why not man? The moment we say some biological adaptation is impossible, we find it somewhere in the animal kingdom, if not in a Himalayan monastery.

It isn't the science-fiction fantasists who are being unrealistic, but conservative scientists. Two lines of research are advancing at a great rate. Farthest ahead is the bio-

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mechanical or bio-electronic approach, which would supplement or supplant body functions with mechanical or electronic aids.

More profound is the biological approach, which seeks to understand adaptive mechanisms in other forms of life and apply them to man. Instead of hooking up a transistorized organ, the object here is to enable the subject to *grow* one. This is not as inaccessible as it sounds. Remove one kidney and the other one grows large to sustain the load.

Wonders or horrors? What guide can we look for to direct us in the development of these new powers? For if we can raise people's general performance with stimulants, we can also reduce them to automatons with depressants, and dissociate them with hallucinating drugs. We can interchange their organs or intercept their heredity by scrambling their DNA. In short, we can alter them in any direction, letting loose in the world forces more powerful and menacing than anything that came out of the atom.

As in the case of the atom, are we going to back into this and find ourselves facing catastrophe without a policy? I have no answers to this question—simply a plea that we start thinking about it.

Let us plan to improve man as we modify him. Let us, while taking over from nature, follow her lead. The keynote is gradual improvement. We should try to optimize those capacities and abilities man already has, by all means available, but avoid radically tampering with the basic mechanism.

In contrast to the astronaut who accomplishes his space mission at the cost of trading most of his physiological systems for electronic ones, whose mouth is sealed, his lungs collapsed, his body wastes recycled through himself, his neural pathways partly severed, and his emotions dissected out—we see another. We envision a man who looks quite normal, but who has been adapted to the oxygen requirements of a Himalayan Sherpa, the heat resistance of a walker-on-coals; who needs less food than a hermit, has the strength of Sonny Liston, and runs the mile in three minutes flat while solving problems in tensor analysis in his head. We call him Optiman, and we think we can make him in the near future.

If we don't, the Russians will. ■■

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[Continued from page 86]

We don't need bombings to blast home the point that railroads are vital to our daily lives; we need education. A surprising number of Americans who have been affected by deteriorating passenger service believe trains are as doomed as dinosaurs.

Labor spokesmen complain that management encourages this myth of the dying monsters to gain public support for layoffs. If true, it's bad business. If not, rapport with the public is at least at low ebb. Railroaders should blow the roundhouse whistle and tell the folks: "Our freight business should be better. Still, this year we'll carry a *billion-plus tons* of goods. What do you think would happen if that load were dumped on the highways?"

Tying pride to profit. Also overdue is the persuasive method SNCF uses to win friends and influence people. Record-holders like its Mistral and Sud Express—which slithers 360 nonstop miles from Paris to Bordeaux in 283 minutes—keep the railroad image bright in the Frenchman's eye.

You can argue that scores of American highliners have been scratched from the train sheets for want of patronage. Yet Gallic flyers are jam-packed, despite healthy competition. Don't kid yourself about French highways—they're good, and motorists drive them very briskly in economical cars. But realistic fares, amazing comfort, and long point-to-point fast running still make the train the best travel buy. The low fares, determined by a more kindly bookkeeping method than ours, force a traveler to think twice before rushing for an airline ticket.

I recently paid $37.75 for a first-class-train trip from Paris to Nice—676 miles—on the Mistral. The ride was an adventure in good traveling comparable to a smooth voyage on a cruise ship. I have no complaint against Air France for the return Nice-Paris flight by jet that saved me seven hours. An economy-class seat, at $36, wasn't available, so I paid $55.20 for a rough ride over the Maritime Alps—plus a French breakfast. Aboard the Mistral, an elaborate five-course dinner, including wine, had set me back less than $5. SNCF holds down the cost of this service by offering a single type of meal at each sitting. But the courses are varied enough to suit a gourmet.

Catering to a booming tourist trade, the system provides a whole fleet of panoramic-windowed rail cars, strategically scheduled for daylight runs on its most scenic routes. To these are added TEE (Trans-Europe-Express) trains, operated jointly with other continental carriers. Between Paris and Dijon, the low-slung Cisalpin matches the Mistral's 82-m.p.h. average speed.

The happy commuter. Rail commuter traffic in a number of metropolitan areas is heavier than ours—creating an even more acute problem of idle equipment between peak periods. Under nationalization, the twice-daily train rider doesn't have to worry about unprofitable suburban service being discontinued. And SNCF doesn't let down in its efforts to wring the best possible mileage from locomotives, coaches, and self-propelled train sets assigned to commuter runs. Here, the Frenchman's fondness for riding the rails on holidays is a help. On such occasions it's common for daily main-line patronage out of Paris alone to jump from a norm of 50,000 passengers to 250,000.

In another bid to ease the problem, a new type of electric locomotive doubles as a passenger job during rush hours and a freight hauler when traffic slacks off. Simple rocker-arm devices to change gear ratio between motors and wheels do the trick.

France, some theorists claim, is just too big to favor rail passenger service over airlines, just too small to give rail freight service an edge over trucks. But just as the Mistral and Sud Express deflate the first part of the statement, SNCF's fleet of merchandise haulers punctures the second.

What accounts for the endless parade of freight trains over the network of lines? A combination of many benefits. Schedules are fast and punctual. Terminal holdovers are short. Vast attention is given to efficient freight handling at way stops. Specially equipped tractors, for example, load and unload container-car units and piggyback trailers at points where we'd consider such operations impractical. Door-to-door delivery is offered almost everywhere.

Finally, the morale and esprit de corps of SNCF personnel is high. Secure in the knowledge that they won't be laid off before retirement, the old heads are happy at their work. And the 10,000 new employees taken on each year bring in the enthusiasm of youth, undampened by the fear of being bumped by an archaic seniority system. ■ ■

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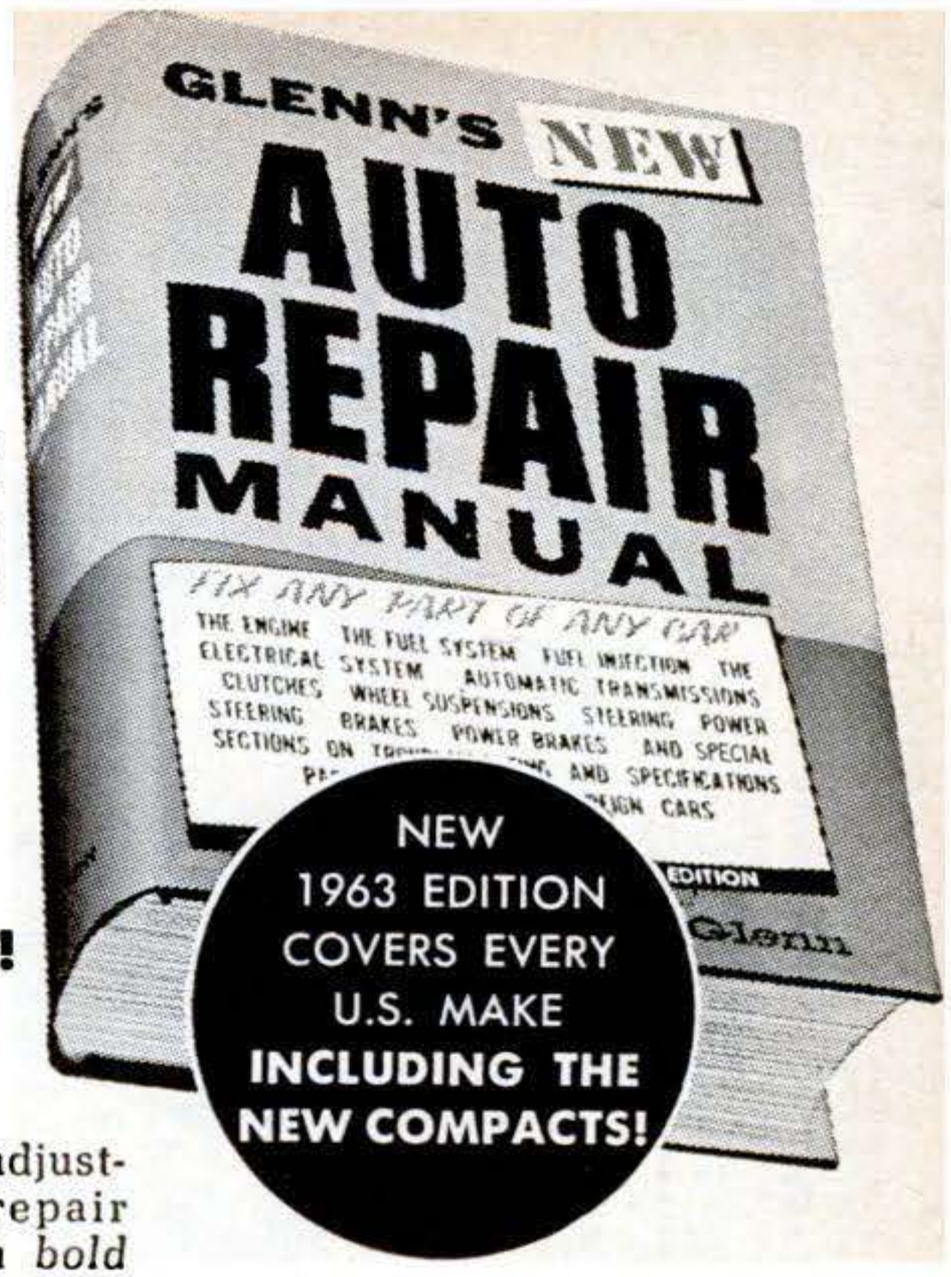

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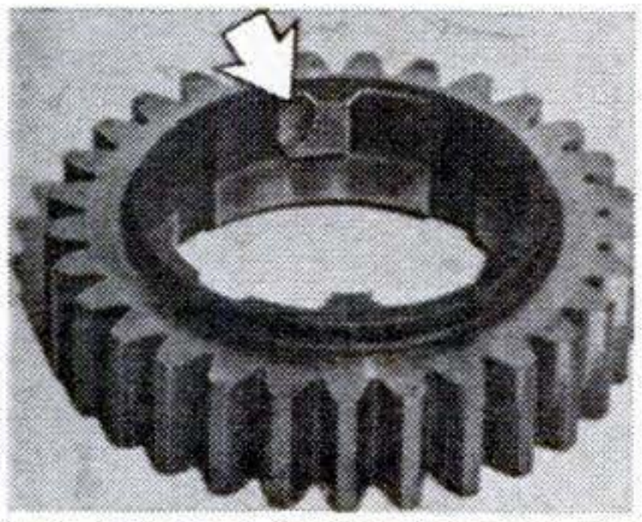

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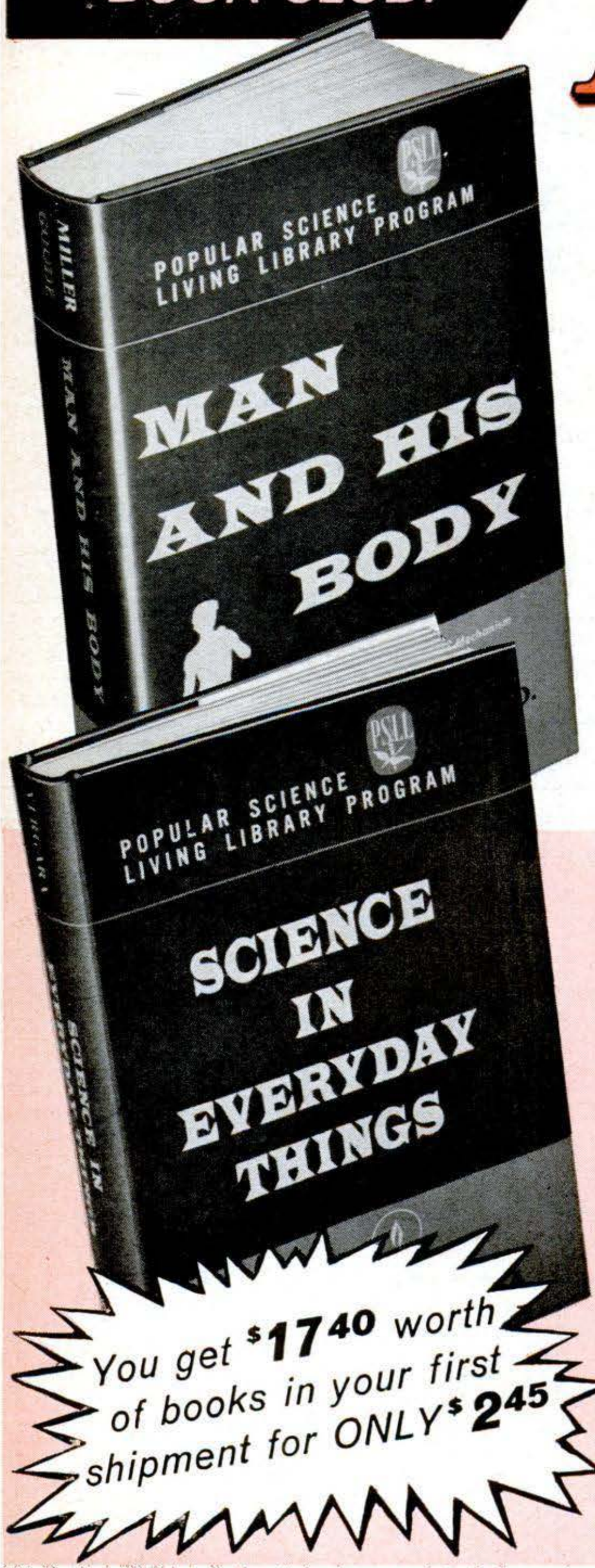

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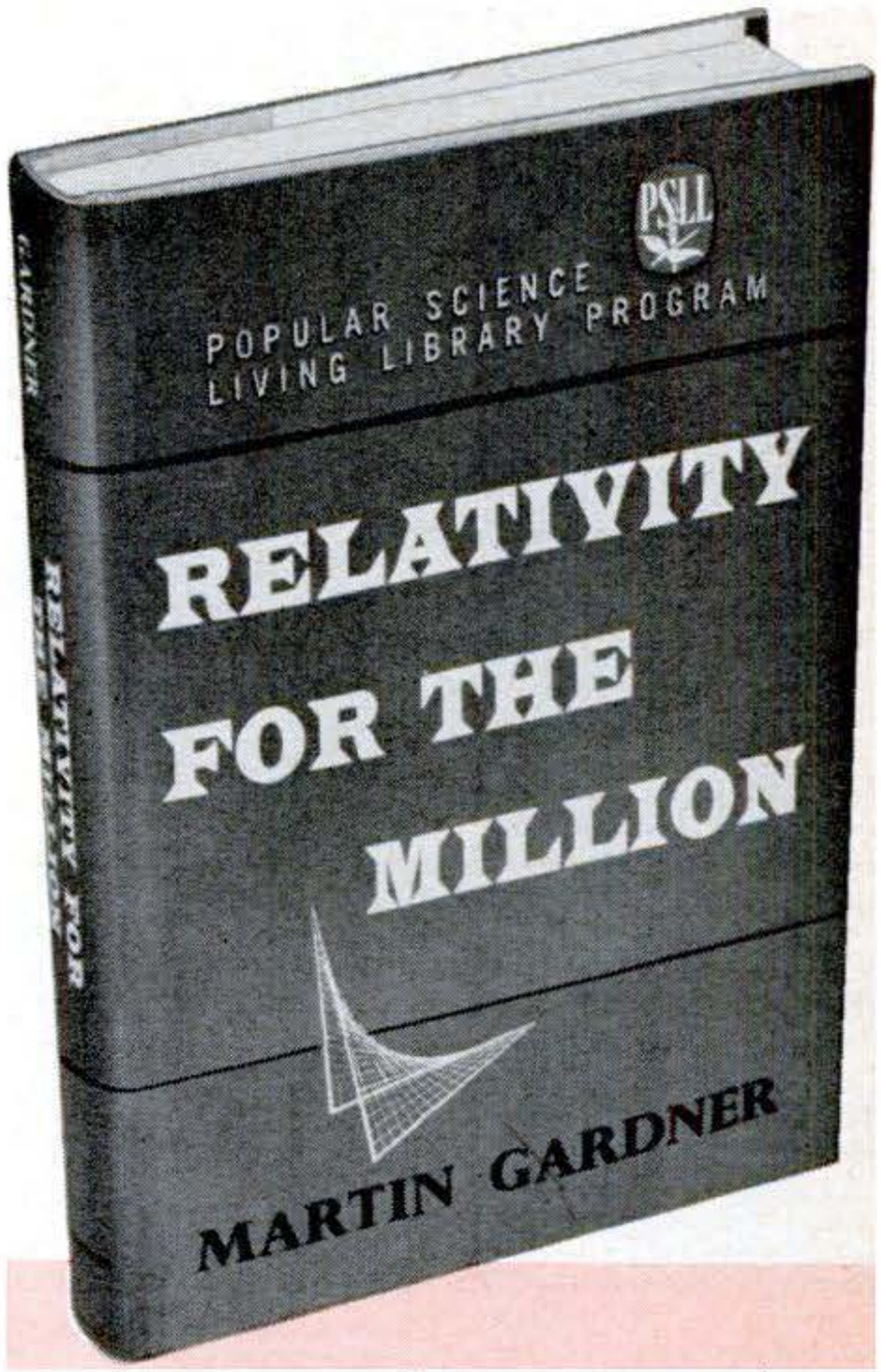

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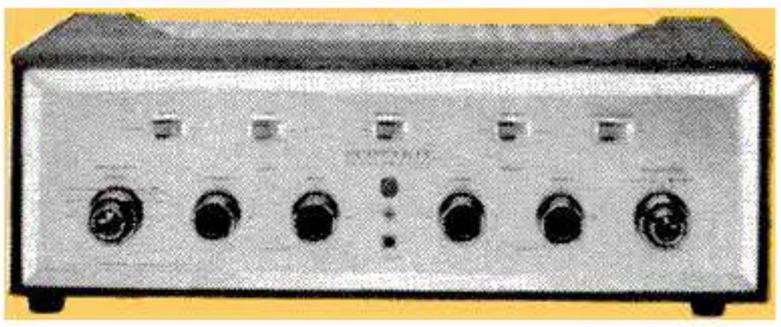

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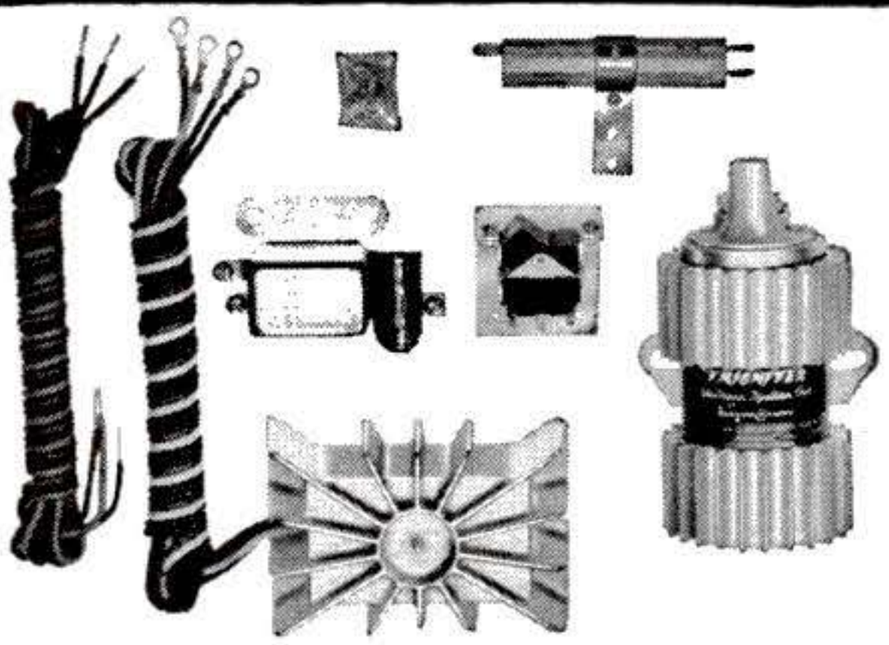

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Jim Roe Pre-Tests the '64 Outboards
[*Continued from page 111*]

a 1/10-scale 90S. With full controls handily located, maneuvering was no trick at all. We checked out the Sportwin's shallow-water drive. You just push here, pull there, and the prop is at surface level.

Besides the new Model 90S and 9½-hp. Sportwin, there are 1964 Evinrudes with 75, 60, 40, 28, 18, 5.5, and 3 hp. All are designed for the new 50:1 gas-oil ratio.

Sea King offers a range

Horsepower ratings in Montgomery Ward's Sea King line start at 3½ and include models at 5, 8, 20, 45, 50, and 80.

I tested the new two-cylinder 50-hp. model on an Illinois lake, powering a Sea King fiberglass boat. This new motor packs a lot of horsepower in two cylinders and just 142 pounds of weight. The cooling system has a thermostatic control. Starting is electric, with an emergency-starting collar under the cowling. An alternator-generator maintains full battery power. An acoustical chamber is designed to seal in motor noise, and the underwater exhaust outlet is designed to compensate for propeller torque.

I found the 50-hp. motor-and-boat combination a nice-handling unit, with fast pickup, good idling, and lots of speed.

McCulloch is the name now

The McCulloch Corporation has dropped the Scott name from its outboard motors, and the entire 1964 line of 11 models will bear the McCulloch name. Seven are pleasure boats in horsepowers of 3½, 7½, 9½, 14, 28, 50, and 75. Two are work-boat power plants—the Ox 140 and the Ox 450. Two are competition motors—the 290 and the 630.

McCulloch engineers have developed a big-bore, short-stroke motor which they feel develops horsepower very efficiently. The new motors operate on a low-friction principle that allows the use of McCulloch's 100:1-ratio oil. According to the engineers, these features, plus the cool-operating surface-gap spark plugs, increase spark-plug life to as much as 800 hours.

Another McCulloch feature is the built-in Shallowater Drive. This allows you to tilt up the motor from the driver's seat.

A major project of McCulloch research has been the development of a new compact

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configuration of the cylinder-head combustion chamber in the 50- and 75-hp. motors. In this design, the spark plug is moved from the edge to the center of the combustion chamber—a move the engineers say allows for smoother operation and boosts horsepower with less fuel consumption.

McCulloch continues to include a Bail-a-Matic pump as standard on all except the 3½-hp. and competition motors.

Two new Sears fishing twins

Sears has two brand-new fishing motors for 1964: the new Ted Williams "twins." These two-cylinder motors are look-alikes from the water line up, but one has 7.5 hp., the other 9.5

The 7.5 is fitted with a "weedless" prop and lower unit for trolling in shallow, weedy waters. The 9.5 has a larger prop and high-performance lower unit, for use in more open waters. Both twins have an auto-bail to help keep your feet dry. And they are low-slung in design, peeking only 7½" above the transom.

Other models in Sears' Elgin line include motors of 3.5, 14.1, 28, 45, and 75.2 hp. The three largest (the 28, 45, and 75 hp.) have alternator-generators, remote tank, and 300-gallon-an-hour auto-bail.

Homelite: the only four-cycle

Homelite continues to produce the country's only four-cycle outboard motor, the 55-hp. model. This four-cylinder motor burns standard gas, requires no oil mixing.

Its principal feature is fuel economy. Other features stressed by their engineers are the Homelite's ability to troll at slow speed for long periods without spark-plug fouling, and its smooth idle. An alternator-generator and electric starting are standard.

Five Perkins from Britain

Perkins for 1964 offers outboard motors of 4½, 6½, 18, 30, and 40 hp. The 30- and the 40-hp. motors feature automotive-type poppet valves and the 18 is said to be the only outboard of its size offering electric starting as standard equipment. These are designed for improved pickup, thrust, and fuel economy. On the 30- and 40-hp. motors, a magneto alternator and radio-interference noise suppressor are standard. ■ ■

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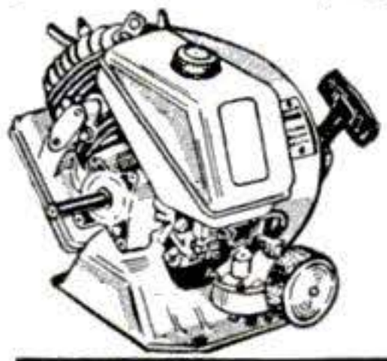

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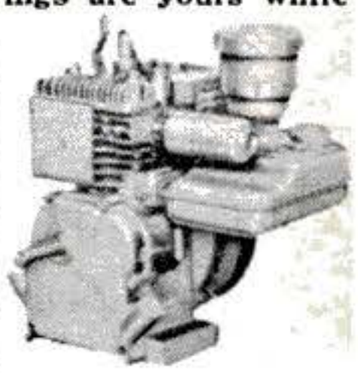

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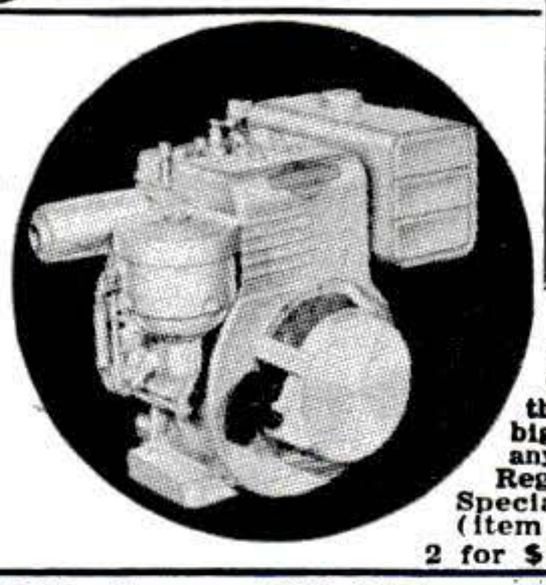

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[Continued from page 100]

severe, life-threatening blood disturbances. Yet the drug remains available because it has a remarkable effect in some infections that resist all other drugs. Doctors use it when essential—and make blood studies so they can stop its use at the first sign of blood trouble.

Antihistamines, and also some tranquilizers and pain relievers, sometimes cause sudden, irresistible drowsiness. Not long ago, a Chicago man, suffering from a severe cold, saw a doctor at lunchtime, and got an antihistamine. Driving home that evening, he fell asleep at the wheel, ran into an oncoming car, and spent four weeks in a hospital.

Does heredity have anything to do with how you react?

Apparently, in some cases. During the Korean War, one out of every 10 American Negro soldiers who received an antimalarial drug, primaquine, developed a blood disorder: acute hemolytic anemia. It turned out that these otherwise-normal men had an inherited deficiency of a single enzyme in their red blood cells that caused the reaction.

Another example: A drug, succinylcholine, is often used with anesthesia because it relaxes muscles briefly, makes surgery easier. But some people have an inherited abnormality in a body enzyme that ordinarily disposes of succinylcholine, and their muscles stay too relaxed too long.

Should pregnant women take drugs?

The thalidomide tragedy alerted medicine to this whole new problem area.

Here was a sleeping pill free of hangover and highly effective. Introduced in West Germany in 1957, it seemed entirely safe—until the totally unexpected discovery that many pregnant women who took it gave birth to babies without arms or legs.

Apparently, at a critical stage early in pregnancy, thalidomide can damage an unborn child—much as German measles early in pregnancy may produce infants with malformed hearts, eyes, ears, or other organs.

Now there is some suspicion that other drugs, most of the time useful, can have harmful effects when taken during pregnancy. Many physicians today urge expectant women to avoid taking all but absolutely essential medication—especially in the very early stages of pregnancy.

Will the new laws make drugs safer?

In some ways, yes. They greatly tighten new-drug testing procedures. In the past, when a drug manufacturer found a promising new chemical, it was first tested on animals to see what effects it had on blood, liver and kidney function, growth rate, etc. If it passed the tests, human trials began.

Usually, a few experienced doctors in big medical centers did the first studies with hospitalized patients under close observation. If the drug seemed safe, it then went to doctors in private practice for further investigation.

Finally, the manufacturer applied to the Food and Drug Administration with evidence of safety. If the agency was satisfied, the drug could be marketed.

Sometimes FDA had no idea a drug was being tested until the company applied for a marketing license. There were charges that some companies cut corners in testing, giving a drug for trial use to physicians not well qualified to evaluate it—and parceling out samples to others on a hasty, wholesale scale, more to promote than to test. There will be no more of that.

Now drug firms must file voluminous reports on all planned testing with FDA, along with detailed qualifications of the doctors doing the tests. FDA must be notified promptly of any adverse reactions during human studies.

Can the laws insure absolute safety?

No. One trouble is that tests aren't 100-percent predictive. Animal experiments are helpful, but animal reactions can also differ considerably from those of man. Careful investigation in human patients before a drug is released for general use is more valuable. Still, as Dr. Modell points out, "It does not tell the whole story . . . The full extent of both the risk and the ultimate benefit of the drug is learned only after extensive use in actual practice—usually for two or three years."

But under the new laws, after a drug has been released for marketing, the manufacturer must report promptly to FDA any information he gets about adverse effects. If it indicates a drug is dangerous, the FDA can act quickly.

At the moment, one of the oral con-

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traceptives that has been available for several years is the subject of debate. The FDA has recommended that women over 35 using the drug be warned of an apparent hazard of blood clotting. The label must state that the drug should not be used by women with certain cancers of the reproductive system, liver trouble, or previous blood-clotting problems.

Another current controversy rages over antibiotics. FDA, on the recommendation of a group of science advisers, would like to eliminate these drugs as an added ingredient in popular multi-acting cough lozenges, nose drops, and other locally applied cold remedies, on the grounds that the drugs are useless. (Antibiotics kill bacteria but not viruses, which cause the colds.)

Further, FDA would like to ban antibiotics from multi-ingredient products that are swallowed. The agency feels that people take, and doctors prescribe, antibiotics too freely. The results may be increased drug resistance plus the undesirable effect of destroying the natural bacteria present in the body.

What can you do to protect yourself and your family?

Don't let the side-effect problem scare you away from necessary medical treatment. Remember, 4½ million Americans are alive today who would be dead if mortality rates of just 25 years ago still prevailed. Thanks to drugs, the influenza death rate has dropped 90 percent and the tuberculosis death rate 83 percent since 1944, while deaths in childbirth have gone down over 90 percent in the last 22 years and infant mortality rates have been almost halved.

If you're allergic to any drug, carry some warning in case of emergency.

Don't let your friends—or yourself—prescribe for you. When something is wrong, let a doctor find out.

If he does prescribe a drug, ask him what side effects may occur. If you know, for example, that a certain drug may produce drowsiness, you can avoid driving or using dangerous machinery until you're certain the drug doesn't so affect you.

If there are other side reactions, report them to your doctor immediately. Even if they're only minor, it may be possible to get rid of them by changing dosage or by switching to another similar drug that, for you, may work just as well. ■■

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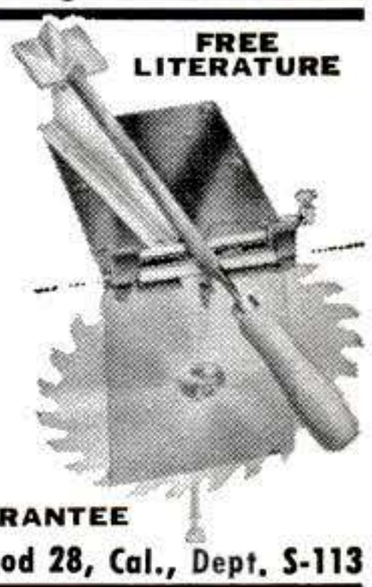

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[Continued from page 73]

"That's San Nicolas Island, on a microwave hookup," my NASA guide explained. "The antenna there—a 60-foot parabolic reflector—is already aimed toward the point on the horizon where Tiros will rise. San Nicolas receives the transmissions from the bird, and relays the pictures to us by microwave."

"Beacon acquired at 30-30," said the loudspeaker.

"That's the radio beacon on Tiros," I was told. "The antenna at San Nicolas is locked on it now. The bird is within receiving range—1,500 miles."

The loudspeaker announced, "Two minutes to Alarm 1."

"There's a preset timer for each tape on the bird," my guide explained. "It works like an alarm clock. We set it by radio command on a previous orbit. The cameras are triggered by timers, and so, too, are the transmissions from the tapes. A transistorized FM transmitter sends the TV signals to the ground station."

Pictures of the pictures. "When the alarm goes off," my guide continued, "a 35mm still camera up there"—he showed me where it was fastened to the instrument panel—"will automatically photograph each TV frame on a kinescope as it is received."

"I can't see the pictures?" I asked.

"Not till they've been developed and printed. We've got a trailer darkroom just outside. We'll have prints in 24 minutes."

"Alarm 1 off on time," declared the loudspeaker, and I heard the camera begin to click, at three-second intervals. The vivid green line on a nearby oscilloscope leapt into a series of jagged peaks and valleys. Out of a slit in the face of a panel crawled a strip of perforated tape.

"It's punched, via telemetry, by one of the light-sensitive cells on Tiros," my guide said. "Each cell reacts when it sees the sun. There are nine of these cells on Tiros. By adding the time between reactions, we find out what the bird's spin rate is. It has to spin like a top to remain stable. But it spins slowly—eight to 12 times a minute."

The recording camera had stopped clicking. A NASA man headed for the darkroom. It had taken three minutes to acquire 32 cloud pictures from Tiros VI.

"Where were they taken?" I asked.

"Down the east coast of India and diagonally toward Indonesia," a waiting Weather Bureau meteorologist told me. "A little over three hours ago. We had to sit out two orbits until the bird came near enough for us to receive the transmission."

Twenty-five minutes later, prints were delivered to the meteorologists. I looked over their shoulders as they superimposed latitude-longitude grids on the photos. Considering that they were taken at a range of 400 miles, by TV cameras traveling 17,000 m.p.h., they were astonishingly good. I could even recognize India.

Typhoon for Indonesia. Mostly, the photos were of clouds over expanses of ocean. Sometimes they were mere puffs. Sometimes they obscured the Indian Ocean like a fluffy white curtain. In one shot, the cloud mass looked like a whirlpool.

"That's a typhoon," a Weather Bureau man explained, "headed for Indonesia."

Within three-quarters of an hour, the meteorologists had made a map combining the findings of Tiros VI's 32 photos. It described the cloud formations over an elongated strip of earth's surface some 4,000 miles long and 800 miles wide.

"This is called a Neph, or cloud, analysis," I was told. "We now put it on a facsimile transmitter. The Weather Bureau in Washington will have a duplicate of it in 10 minutes. Then they'll broadcast it to the Far Eastern areas concerned. Every 24 hours, they send 8 to 20 radio-facsimile cloud maps to all our own weather stations and to other nations around the world.

"When Nimbus is in orbit, too," my NASA guide added, "the coverage will be much more complete. We're building a CDA station for Nimbus at Fairbanks, Alaska, and another one, with Canadian cooperation, at Ingomish, Nova Scotia.

"With Nimbus and Tiros both reporting," he added, with a grin, "we're not likely to get many weather surprises.

"After Nimbus will come Aeros," he continued. "Aeros will ride in a much higher orbit, and its speed will exactly match the earth's, so it'll watch just one area continually. Try and sneak a storm past Aeros!"

As we stepped out into the soft, sea-scented night, my guide drew a deep breath and said, "You know, despite what the pessimists say, I'd rather be alive in this marvelous age than at any other time in history."

I felt pretty stimulated myself. ■■

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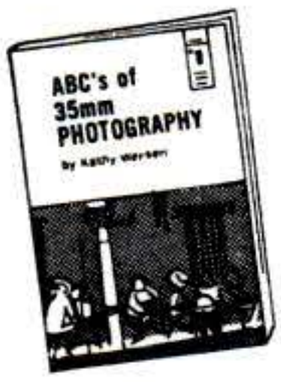

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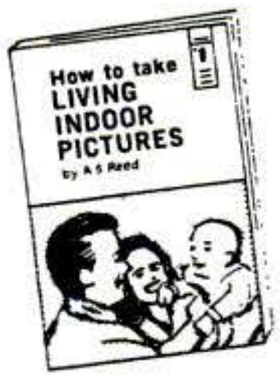

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[Continued from page 76]

Then, just before the fourth blast, as one of the men leaned over the wires, Gurney let out a yell. "Hey! Watch it!"

The man straightened. "What the . . ."

Gurney pointed at the flashlight dangling from the man's belt. "Where in Sam Hill did you get that?"

"Bought it," the man said.

"Take it off and get it out of here," Gurney ordered.

Checking back, he found out that one of the men who had been killed had also lost his regulation rubber-covered flashlight and substituted a metal one. It must have touched the detonation wire—and boom!

Proving the point. A safety sleuth takes the badge of his job—the hard hat—seriously. He'd feel naked without it. On spotting a worker without a hard hat, he may set up a little demonstration, like having a hammer dropped from a scaffold onto his head. Thereupon he will take off the protective helmet and display the dent.

"Rather have that in your head?" he asks.

On jobs where goggles should be worn, the safety man has another ploy. He gives the offender an object.

"You'll be needing one of these," he says. "I can get it for you wholesale."

The recipient turns slightly green and puts on his goggles when he looks at the glass eye he's been handed.

Art Lundeen, from Boston, was checking up on a pipeline job when he saw the men doing something that made his hair stand on end. They were "riding the pipes"—balancing on them as they were lifted by derricks.

"It was a cinch somebody was going to get killed that way," Lundeen says.

His admonitions to the workers brought only guffaws. "You don't know what you're talking about," they said.

"Watch," said Lundeen, and climbed aboard a pipe. While the men below looked on he rode it like a veteran. Then, when it was high aloft, he pretended to lose his balance and went through a silent-movie routine of struggling to keep from falling.

Back on the ground, when he talked to the men, they agreed to stay off the pipes.

"It looked different with you up there," they admitted.

Years of efforts by safety engineers have made American workers safety-conscious.

"They go along with us pretty much of the time," says engineer Lloyd Porter, "but on the foreign jobs—*whew!*"

He has reason to wipe his brow, as do his fellow engineers who've encountered problems like the Congolese bulb-snatchers. Fires kept breaking out in a sawmill cutting lumber for concrete forms. It looked like arson—and it was, of a somewhat peculiar variety. In the first place, native workers made off with the bulbs. Then warriors showed off by sticking spears into the empty sockets. Result: a satisfying shower of sparks, a short circuit, and another fire.

Gasoline hazards. Checking an airfield construction job in Haiti, Porter shuddered when he discovered that workers carrying gasoline drums on their shoulders were smoking.

Porter waited until he spotted a man carrying a leaking can, with gasoline running down onto his shirt, inches away from his cigarette. He walked up, plucked the cigarette from the man's mouth, then asked him for his shirt. The worker looked around wildly, as if to escape from this madman, but finally gave up his shirt. Porter tossed the shirt a safe distance away and threw the cigarette onto it. It went up in a puff of flame.

The cigarette smoking stopped.

Herb Heinrich, working the Middle East, got word to hustle out to a pipeline in Iran. There had been an explosion, a couple of workers killed.

Heinrich found that when the men stopped for a break they built a fire to brew tea. A trucker had run over a pile of gasoline drums and gas had run into the fire. Heinrich decreed no more fires and sent off for a supply of thermos bottles so each worker could carry his own hot tea.

"On some foreign jobs we've got a real tricky factor—animals," says Howard Kessler. Take the case of the forgetful elephant.

Kessler had just left a bridge-building job in Burma that he'd checked out for safety. He had everything settled. Cooperative workers, a safety-conscious contractor. Nothing could go wrong with *that* job. Yet he came back to find the bridge a tangled mass of wreckage in the river below—and several workers injured. A five-ton elephant carrying beams hadn't stopped at the water's edge but had gone right out onto the half-completed bridge. ■ ■

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[Continued from page 116]

for advanced weight lifters on the old models. It also makes possible precise positioning of the motor when the ways are horizontal.

● The new table is bigger than the old, giving you more room to maneuver on. I've always felt that the previous tables were undersized for the machine's capacity. Now this has been corrected. There's also a clever two-way extension for the table that you'll probably leave in place more or less permanently.

● All four of the steel support tubes are now part of the moving mechanism. They tilt with the motor, giving the machine extra rigidity right where you want it. Previously, two of the tubes were merely a fixed part of the stand.

● They've added another new trick, too —a built-in, vacuum dust-collector system. This draws dust from sawing, sanding, and other operations into a removable paper bag. The flexible vacuum hose can also be hooked up to provide a blowing action for quick cleanup of hard-to-reach parts.

What you get. With a motor rated at 1⅛ hp., the Mark VII is a husky piece of equipment. As a table saw, it gives you 10″ capacity—bigger than the previous 9″ models. With the outboard support set up, you can cut a 4′-by-8′ sheet of plywood neatly in half with no sweat. Fine adjustments can be made with the spindle quill—something you can't do on a conventional table saw.

The Mark VII incorporates the same continuously variable speed changer as its predecessor, the Mark V. This gives you a full range of speeds from 700 to 5,200 r.p.m. at the flick of a dial for anything from slow metal-drilling to fast shaping. The ability to operate each tool at its correct speed is one of the important features that make the Shopsmith a truly useful multipurpose machine.

As a wood lathe, the Mark VII provides 34″ between centers and a generous 16½″ swing—more capacity than most turning jobs ever require. In fact, the basic Shopsmith design is considered by many craftsmen to be an especially fine home-shop lathe because of its sliding toolrest.

The sanding disk is a double-faced affair, flat on one side and conical on the other. You use the conical side for final smoothing, leaving no swirl marks. With the regular saw fence, miter gauge, and table tilt, you can do accurate chamfering, jointing, planing, and other critical sanding jobs. As with earlier models, another handy feature is the Shopsmith's ability to function as a horizontal drill, boring holes in stock of almost unlimited length.

Any drawbacks? I did find a few points about the new Mark VII that may take some getting used to. For instance, after a good many years of learning to tighten and loosen things with knobs, I was bothered somewhat by the "flip-lock" principle that is used throughout. Whenever you want to lock a setting or adjustment, you flip a handle. This turns a cam or eccentric that snugs things up tight. In some cases, the lever is also a crank handle. In all cases, there is a "smooth" side and a "rough" side so you can tell by feel or by sight whether you've flipped the lever in the right direction. The system may prove to be a good one, but it seemed a bit clumsy to me.

As a shaper, the Shopsmith is somewhat slower at its top speed of 5,200 r.p.m. than conventional shapers, but it did perform adequately on several shaping tests.

As we went to press, Shopsmith was planning to drop the labels from the speed-changer dial that tell you in words just where to set the dial for each operation. Unless they've changed their minds in the meantime, you now have only r.p.m. numbers on the dial and will have to memorize the various speeds or consult the manual.

I have a feeling, too, that the dust collector, a fine feature in theory, may prove cumbersome in actual practice—just one more thing to change when you switch from one operation to another. As a cleanup aid, it's great. But most of the time I think you'll tend to use it *after* the job is finished —not while it's in progress.

But these are largely quibbles. The new Mark VII represents a big advance in the art of combination tools. Individual tools of comparable quality would be expensive. Added up, they'd far exceed the $369.50 that Shopsmith is asking for its newest brainchild. In addition, all of Shopsmith's Add-A-Tool accessories, made to fit the Mark V, can also be used with the Mark VII. These include a jigsaw, jointer, bandsaw, belt sander, and spray-paint compressor. All in all, the Mark VII is an impressive and exciting power-tool package. ■ ■

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Catch a Falling Star?

[Continued from page 121]

be using longer exposures. Auroral displays generally are best during the years of maximum sunspot activity.

Since the introduction of fast color films, such as High Speed Ektachrome, it has been practical to shoot the brighter auroral displays in color. Some interesting color movies have been shot using single-frame exposures of 5 to 10 seconds per frame. With this system, the aurora can be followed as it builds up and diminishes in intensity.

Moon. Because it's the brightest and largest object we see after sundown, the moon is a prime subject for the beginning skyshooter. Practically any small telescope is useful.

A good way to start is to use the prime-focus method, which works without the telescope eyepiece or camera lens (see diagram, on page 121).

Exposures will vary considerably—from one for a bright, full moon to one for a thin crescent moon, where you may want an exposure long enough to build up detail on the shaded side. When photographing a full moon, you're working with a lot of light and low contrast. For better contrast, you may wish to shoot the moon on Microfile film. You can also get more contrast by pushing development. During other phases, regular films, such as Plus-X, give enough contrast.

Stars are so far away that even through large telescopes they show up as points of light. It's necessary to make long exposures to build up the faint rays of light. The longer your exposures, the brighter and bigger the stars will appear. Tracking with an equatorial mount is necessary.

Planets. To show planetary detail, telescopes larger than 6″ are necessary. Bright planets, such as Venus and Jupiter, make good-size images for the beginner. Shooting planets will require a guided system. You'll also need long focal length and short exposures—the larger telescopes give you this advantage.

Nebulas are diffused gas clouds lighted by stars in the area. They're difficult for the beginner to photograph. But a few of the brighter ones can be shot using a 6″ scope and fast film.

A beginner's book, *How to Use Your Telescope*, published by Edmund Scientific Co., sells for 60 cents. ■ ■

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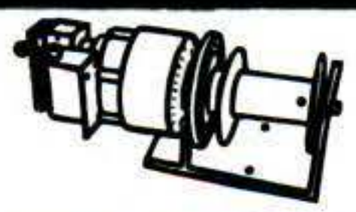

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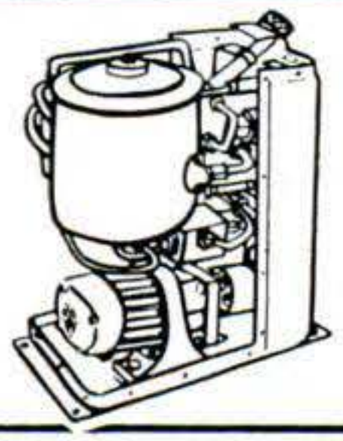

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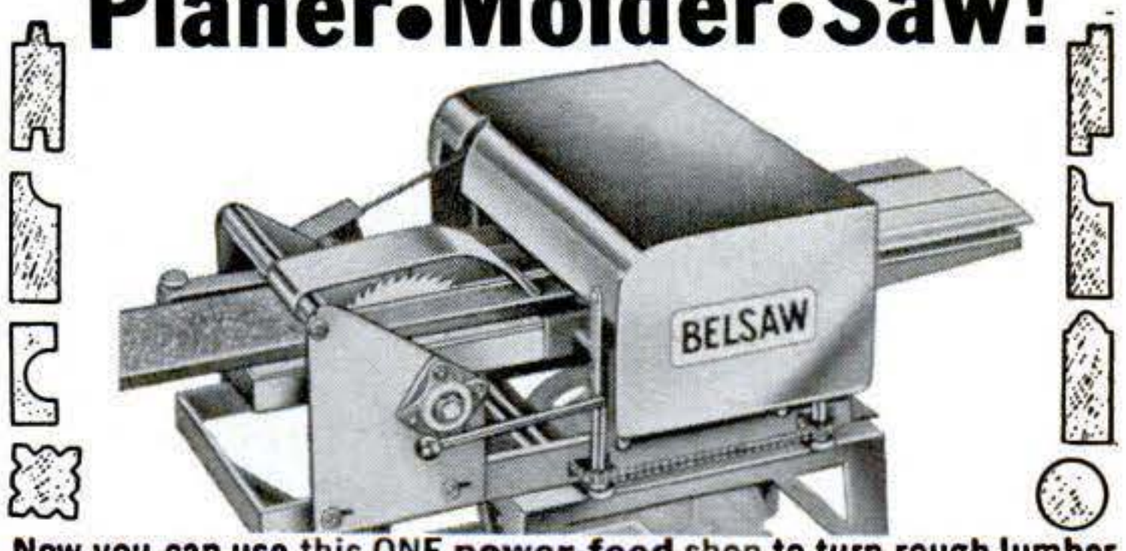

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[Continued from page 93]

nons called "Scare-Aways." During the fall and spring migration seasons these are lined up near runways. In each cannon water drips steadily on calcium carbide, generates acetylene. At intervals of a minute or two each gun fires. The frightening cannonading drives most birds away.

Boston's Logan Airport uses "Zon-Guns," scattered in the grass where birds like to feed and nest. The guns are connected to tanks of acetylene gas, and are fired by automatic timers. Some airports broadcast tape recordings of bird-distress calls. The idea is that birds, hearing these, will fly away. They do, too—but it's hard to fool a bird. "In just 13 days," says the Fish and Wildlife Service's John S. Gottschalk, at Boston, "many birds figure out it's all a fake, and they come back."

At a military air base near Norfolk, Va., the methods are even simpler. When birds are seen, a man merely pokes the snout of a shotgun out of a control-tower window and fires blanks.

But none of these—not even the cannons—are fully effective. Once, when the cannons were firing at Boston, a safety inspector saw a snowy owl fly in and alight on one of the Zon-Guns.

"We waited for the gun to go off," he says. "It was going to give that owl the fright of its life."

Seconds ticked by.

Suddenly the gun fired with a whoop heard across the field.

"The owl," says the FAA man, "sat on the gun and didn't budge. Maybe he even liked it."

That could be. Some birds soon grow accustomed even to the awful roar and fury of jet engines at close range. The surface of Taxiway D at Boston is black with soot belched by jets swinging toward Runway 33. "But we've even seen gulls sit right there in the roaring blast of the engines," says Tom Lee, an operations supervisor at Logan. "They'll stay right there when the planes begin to move."

On patrol. Recently, photographer Bill Morris and this reporter sat with Lee and a guard in the bird-patrol car at the end of Runway 33. Nearby was the spot where that Eastern Air Lines Electra had hit its flock of starlings in 1960 and crashed into the harbor.

An Eastern flight, a big TWA jet, and several others were moving out Taxiway D in a stately parade. Our companions were guarding those planes and were ready if any pilot called for a bird run.

Few birds were around—for Boston's bird patrol has cut down the flocks tremendously. But today, as it happened, there was a sudden flash of wings around us. A flock of 50 sandpipers had whirled across Runway 33.

Tom Lee saw them first—before the pilots or the special bird lookout in the tower, a mile away. Tom grabbed his mike.

"Bird Patrol Six to tower," he called. "We've just sighted a flight of sandpipers. Notify all pilots immediately."

He sounded like an observer reporting an attack by enemy planes.

To us, he added: "We've been getting a lot of sandpiper activity. We'll take care of 'em."

The great jets waited. Lee swung the car. The birds had settled in grass. We went after them. When we came close, Lee stopped the car. He and a guard jumped out, loaded their shotguns and fired. The birds rose.

A quarter-mile away, we heard two sharp reports. Unnoticed, a yellow Chevrolet truck—Bird Patrol Seven—had been waiting, too. As the sandpipers went over, a guard jumped out and fired a shotgun.

He drove to meet us. "Got two of 'em," he said. "*They* won't be back soon."

Tom Lee radioed the tower. The planes took off, and again we saw those smoky ladders rising safely into the sky. We drove back to guard a big jet approaching from Europe.

We understood, then, why the Air Line Pilots Association recently voted heartfelt thanks to Boston's Logan Airport for its remarkable bird patrols—the only airport so honored. ■■

Hot Wings

At some fields, birds roost in hangars. They've been found nesting in tail sections, interfering with controls.

Lately a more subtle hazard has been found. Bird droppings on fast jet wings leave rough spots. In flight, the FAA has found, these generate enough heat to actually burn holes in the wings.

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[Continued from page 55]

different models, a rather modest number compared with some others. These are divided into seven "series." Hold on to your hat, now, for a rundown:

The F-85 series lists a 4-door sedan, 4-door Deluxe sedan, club coupe, sports coupe, Cutlass coupe, Cutlass convertible, 2-seat wagon, and a 2-seat Deluxe wagon. The Jetstar 88 series lists a Celebrity sedan, Holiday sedan, Holiday coupe, and convertible. The Jetstar I series lists a Jetstar I coupe. The Dynamic 88 series lists a Celebrity sedan, Holiday sedan, Holiday coupe, convertible, 2-seat Fiesta, and 3-seat Fiesta.

The Super 88 series lists a Celebrity sedan and a Holiday sedan. The Starfire series lists a Starfire coupe and a Starfire convertible. The 98 series lists a Town sedan, Luxury sedan, Holiday sports sedan, Holiday sports coupe, Custom sports coupe, and a convertible.

"Who *does* all this naming?" I asked a product information specialist at another GM division. "The sales department?"

"No-o," he responded vaguely, "I think it's Top Management."

If you think Olds is hard to grasp, try Plymouth with 35 models, Chevy with 43, or the Ford division with 44.

A three-speed, anyone?

Ford Motor's automatic drives do more than stretch a car's performance. They confuse a car shopper. Don't ask a car salesman to explain the differences among them. They confuse him, too.

A few years ago Ford had a 3-speed drive, Chevy a 2-speed. Chevy's 2-speed was lower priced. So Ford produced a 2-speed to match it. Last year a Ford 3-speed was, however, still an option. The 2-speed was called a Fordomatic (without hyphens), the 3-speed Cruise-O-Matic (hyphens).

For '64, Ford has not two but three automatic transmissions. One is a 2-speed, the other two are 3-speeds.

One of the 3-speeds is available in the Galaxie, Fairlane, and Falcon. The other 3-speed is available in the Galaxie, Fairlane, and Thunderbird. The 2-speed is available only in the Falcon and the Lincoln-Mercury division's Comet.

Got that straight? Now, "L" or low gear on one of the 3-speeds' selector quadrant locks out second and third gears. The other 3-speed has two drive positions, D-1 and D-2. D-2 locks out low gear. The 2-speed doesn't lock out anything.

Got that straight? Then try this for size: Both the 2-speed and one of the 3-speeds are called Fordomatics (without hyphens). The other 3-speed is the Cruise-O-Matic (with hyphens). But then there is an automatic box for the Mercury called Multi-Drive, and one for the Lincoln Continental called Turbo-Drive. (Hyphens, please!) These two automatics also lock out low gear.

Multi-Drive and Turbo-Drive are only the Cruise-O-Matic by other names.

. . . And on the plus side

It would be a shame not to give the devil his due on the '64 cars. If they have faults, these vehicles nonetheless do honor to American ingenuity. The engineers work wonders against odds. Their biggest problem is penny-pinching bookkeepers. Auto making is a nickel-and-dime business. One hero is an engineer who figured out a way to save his company 33 cents on each muffler.

A few years ago an engineer told me, "we're putting one less Phillips screw in the windshield molding."

"So?" I said, puzzled.

"That's a saving of a tenth of a cent," he explained gravely. "Multiply that by a million cars and you've saved $1,000. Find 1,000 ways to save a tenth of a cent and you've saved $1,000,000."

Against such odds, here are only a few of my nominations for outstanding (or endearing or thoughtful or shrewd) improvements in the new crop of cars:

- The new Buick automatic transmissions, shared with Cadillac, Oldsmobile, and Pontiac. Their torque converters are vastly improved. Better clutch materials in the supplemental gears and better lubricants keep shift points constant with respect to load, speed, and accelerator pressure. Some automatic boxes wander.
- Chrysler's self-cleaning Positive Crankcase Ventilation system.
- American Motors' manual over-ride on its automatic transmission.
- Borg-Warner's, Fisher Body's, and Ford's retractable seat belts.
- Cadillac's smart move in putting a

[Continued on page 214]

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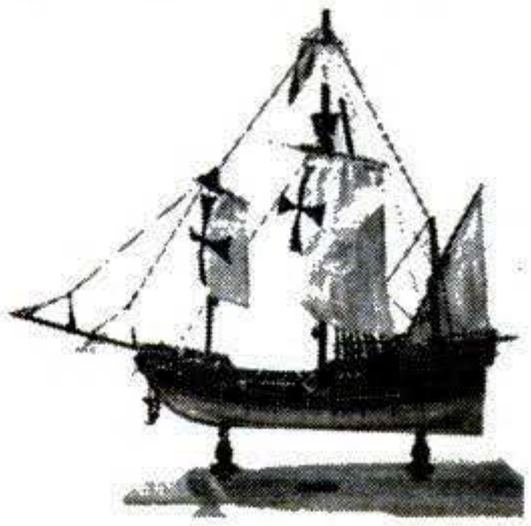

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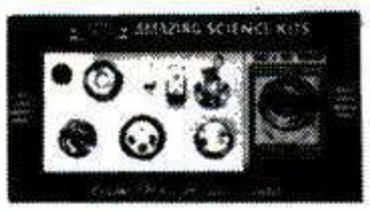

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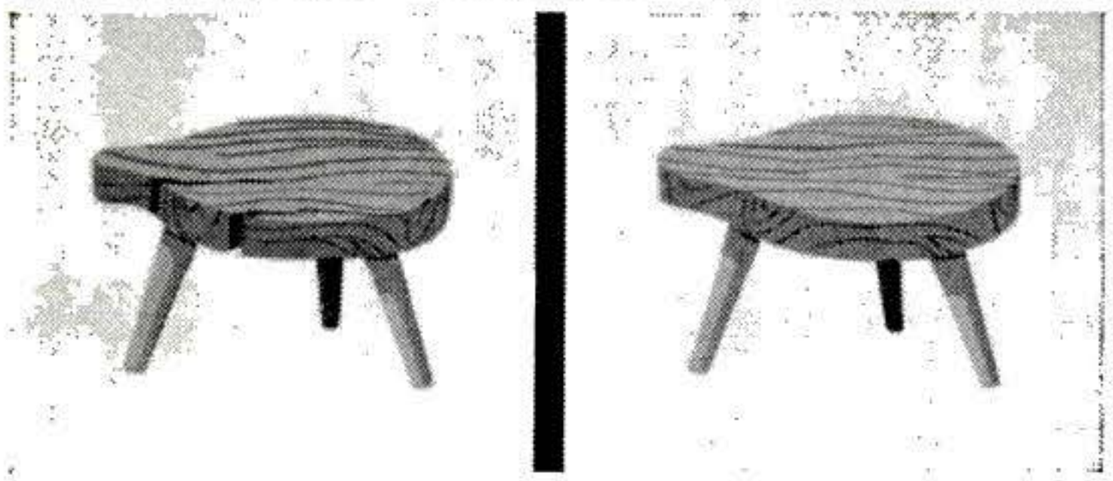

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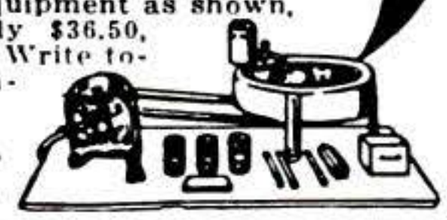

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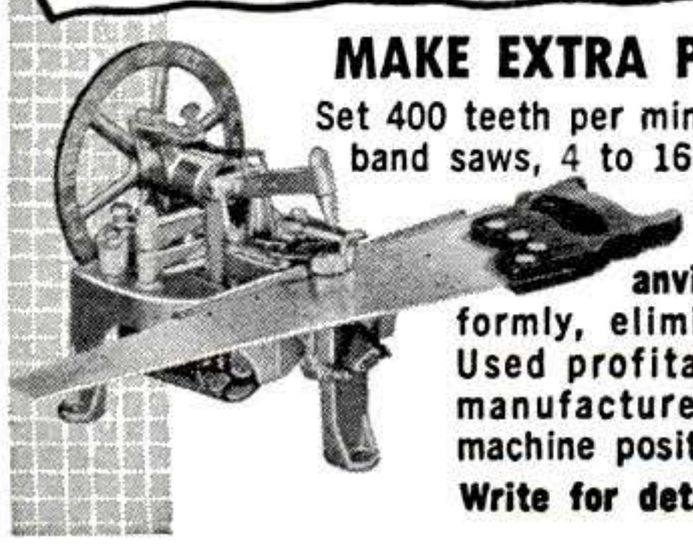

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[*Continued from page 60*]

and steer around some of the larger rocks and shrubs. Eskelson is calmly explaining several technical details to me.

Why rubber tires? Only the two rear wheels are driven, I learn. The other eight freewheel. The reason for rubber tractor tires instead of steel sprockets? Mainly because it's almost impossible to throw a track with this arrangement. The "drop-center" track is shaped to wrap around the tires snugly. An added benefit: Tires are cheaper and last much longer than sprockets. They are inflated to only about 20 p.s.i., and so aren't easily cut by sharp rocks.

A major advantage of the Imp is that most of its parts can be bought off the shelf at any auto-accessory store. For example, each of the two joy sticks used for steering and braking actuates a Ford master cylinder.

Hydraulic operation eliminates linkage. By pulling back on a stick lightly, you slow a band around the planetary gear set in the differential on that side. The planetary setup is similar to that found in car automatic transmissions.

Reducing the speed of one track is the most efficient way to turn. If power were cut entirely on one side, the driven track would dig in and get stuck on soft surfaces. Also, there would be more risk of losing control and spinning out.

We make it down the mountainside. I coast the Imp over to the truck and a technician pours in some gas. The engine cranks and comes alive, and the Imp scoots up a ramp and into the truck bed.

The drive train. Eskelson is filling me in on the rest of the drive train. Connected to the engine, he explains, is a Salsbury torque converter consisting of engine (drive) pulley and countershaft (driven) pulley connected by a rubber V belt. It acts as an automatic transmission and clutch.

Each of the pulleys is made up of two spring-loaded halves and is V-grooved. As engine speed increases, centrifugal weights draw the two halves of the drive pulley closer together. The V groove becomes narrower, and the belt is forced to ride higher. This, in effect, increases the diameter of the drive pulley. As belt tension increases, it draws the two halves of the driven pulley apart. Thus the belt rides

lower and the diameter of the driven pulley is, in effect, decreased.

So far, the system allows infinitely variable ratios. But Thiokol engineers decided that there would be far less belt wear if the system were modified to produce three distinct ratios. Thus a cover is fitted around the drive-pulley flyweights. It has three notches, or levels, cut on the inside at different angles to limit flyweight travel. The flyweights are forced to rotate along one level until centrifugal force becomes strong enough to jump the weights to the next level or weak enough to drop them back one level. Ratios are 3:1, 2:1, and 1:1. When the engine is idling, both drive and driven pulleys automatically return to load-free neutral position with drive belt disengaged.

Beyond the torque converter is a simple mechanical gear reduction of 3:1 achieved with timing chain and gears. Then torque is transferred to the drive shaft, and on to the trans-differential.

Four speeds forward. The transmission, integral with the differential, has four speeds: 2.77:1; 1.82:1, 1.28:1; and .822:1; reverse is 2.38:1. With the centrifugally operated Salsbury drive, no manual declutching is needed to shift gears, but it is advisable to stop the vehicle. Additionally, the pinion ring gear gives a 6.37:1 reduction. The lowest possible final reduction is a staggering 158.8:1!

This isn't the end of my adventures for the day. Before I'm through, I wind up driving the Imp up a 40-degree pile of loose gravel and through a swamp.

I'm convinced. The Imp can go anywhere. ■■

Larger Spryte is powered by a 101-hp. Ford Falcon six. It crosses rivers and lakes without shipping water. Imp also is available in floater form, with an enclosed hull, at extra cost.

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So—I Built My Own Fireplace

[Continued from page 131]

your fireplace unit. Cover all steel surfaces with this before putting masonry against them. You can hold it in place while you work by daubing the steel first with a paste of cement and water. The wool gives a cushion for expansion which otherwise might produce cracking when you build a fire.

Installing ducts. You must provide ducts from the outside of the wall to the two air intakes and two outlets. The intakes should be as close to the floor as possible.

Since the fireplace shown is standing free near the center of a large room, its air intakes could be put at the back. Its outlets are at the ends of the wall, for looks and for heating a large room.

Where ducts are short, they are easily made in the masonry by using wood forms. For very long ones, use ordinary galvanized heating ducts of the kind that roll up and snap together like stovepipe.

Use steel angle to reinforce and support the top of the fireplace opening. A piece of the correct size will be available when you purchase the unit. Use lumber to make a temporary form at this point, setting the stones in a bed of reinforced concrete several inches thick. Pack mineral wool between the angle-steel lintel and the unit.

The flue. After you reach the top of the steel unit you may wish to continue the stone structure full size up to the ceiling or even to full chimney height. Or you may narrow it to normal chimney size, either at the top of the unit or at ceiling level.

In any case, the first step is to place a length of terra-cotta flue liner of the size specified for your fireplace.

The flue liner must be supported by masonry, not by the steel unit. To make sure of this, carry your masonry above the top of the steel and set the liner on it.

Continue upward, adding liner as you go. You should have at least 4″ of concrete around the liner, reinforced with a vertical steel rod at each corner.

Continue the chimney until it is at least 3′ higher than the roof where it passes through. It should also be at least 2′ higher than any part of the roof within 10′.

Finish by sloping the cement upward from the face of the chimney toward the liner. Let the flue extend about 2″ above the rest of the chimney. These are precautions to discourage downdrafts. ■ ■

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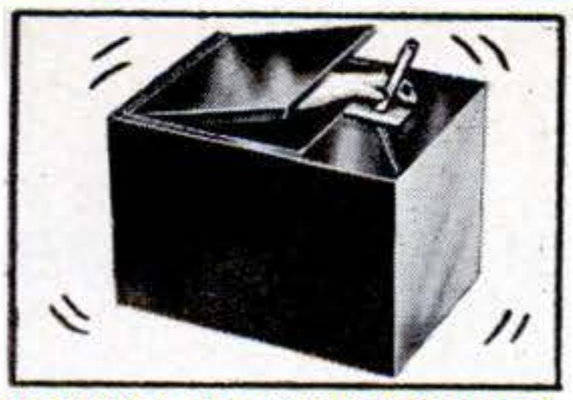

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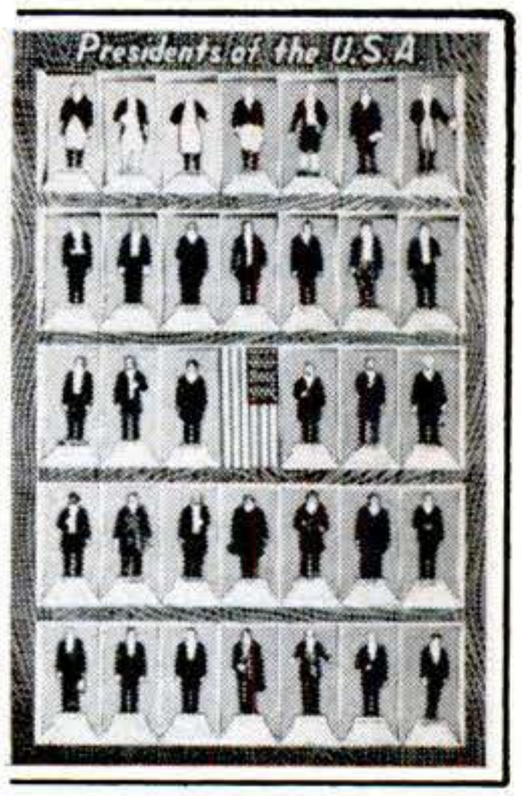

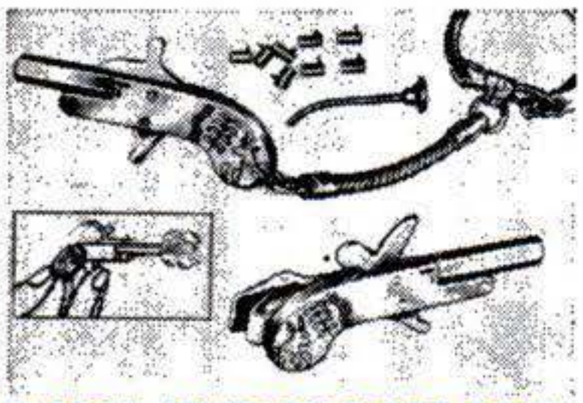

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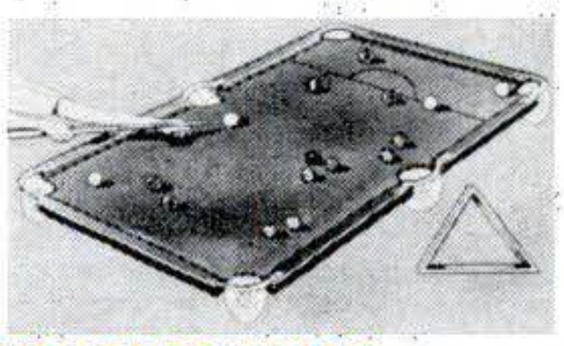

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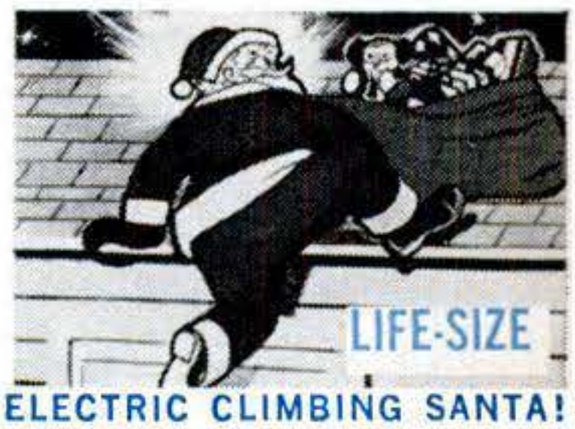

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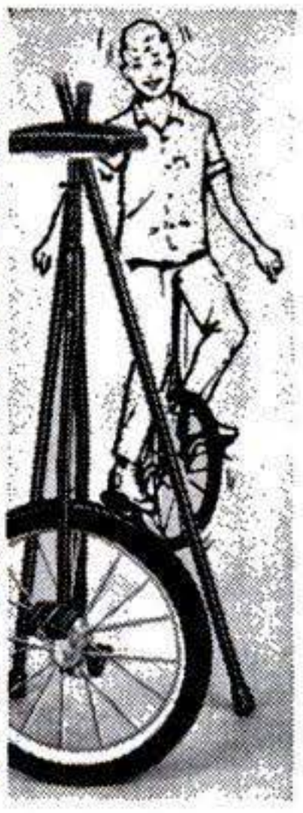

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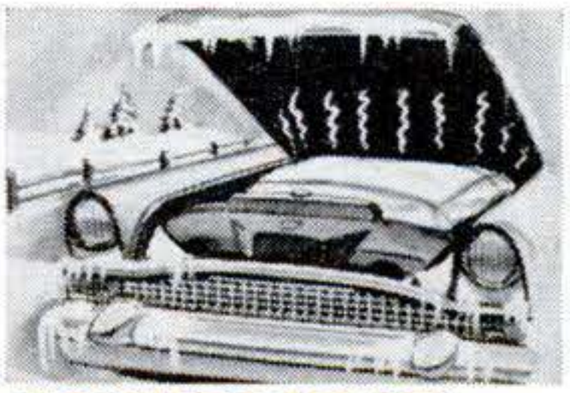

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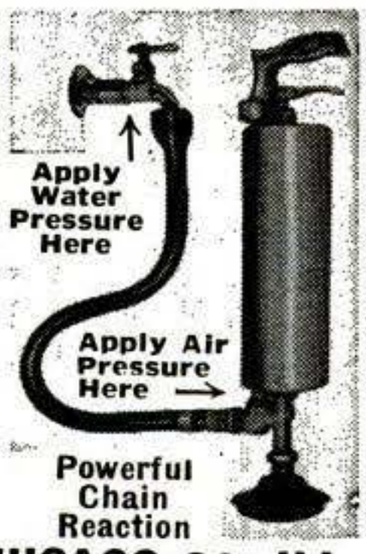

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Confusion, Inc.

[Continued from page 208]

soft plastic tip on the selector lever of its new transmission so that the driver's fingers can sense the difference from the older one. Both boxes are still in use. The quadrants differ. Confusing them could be dangerous.

- Studebaker's shockproof transmission-quadrant light.
- Pontiac's restoration of lubrication nipples on its front suspensions.
- Ford's new method of tightening bolts on cylinder heads and oil pans. It prevents gasket fracture. In 40,000 miles of durability tests by Mercury—equated with 100,000 of owner-driving—not a drop of oil was lost.
- The spread in the use of GM's tiltable steering wheel, notably to some Chrysler and American Motors cars. This wheel probably has been the finest plus in driver comfort in a decade.
- In general, the new cars' rides and handling. In a nickel-and-dime business, they're magnificent. ■■

This One's Gone to the Races

[Continued from page 57]

not, of course, be the Tempest produced by the Pontiac Motor Division. The standard product takes some doctoring. This second-biggest Pontiac engine (the biggest measures 421 cubic inches) produces only that 348 horsepower with three two-barrel carburetors. With the carburetion allowed by NASCAR, it produces less.

The doctoring, actually, is minor. The camshaft is left undisturbed. Not even solid valve lifters are substituted for the standard hydraulics. But the engine will turn 5,600 r.p.m. without valve "pump-up" and consequent "float"—a refusal of the valves to close. The engine can be turned 6,000 r.p.m. without pump-up by the simple expedient of raising the valve train stud heights on the cylinder block.

There are other plusses in the GTO. The springing is stiff enough for racing. The car falls neatly within NASCAR's rules, even to the engine size—for 1964 cubages cannot exceed 396.5 inches. As stock options, Pontiac has four-bolt bearing caps, forged alloy-steel crankshafts, heat-treated connecting rods, and forged pistons.

Despite adherence to the manufacturers' resolution—now openly breached by Ford Motor and the Chrysler Corp.—Pontiac's modest little compact of yesteryear is about to get into some fast company. ■■

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Advertising, Agencies for Advertisers ... 53
Agents Wanted ... 43
Antiques, Relics & Indian Goods ... 29
Art Instruction, Cartooning, Sign Painting ... 54
Authors Service ... 52
Auto Supplies & Equipment ... 2
Auto Trailers ... 3
Automobiles & Midget Cars ... 1
Aviation ... 5

Batteries, Generators, Etc. ... 6
Boats, Inboard & Outboard Motors ... 11
Body-Building Courses, Jiu Jitsu, Etc. ... 12
Books & Magazines ... 23
Business Opportunities ... 37
Business Service, Information, Name Lists ... 50
Buy It Wholesale ... 38A

Cameras, Photo Supplies ... 34
Camping Equipment & Tents ... 16
Christmas Gifts ... A1
Coins & Currency ... 26
Contests ... 46

Detectives ... 47
Do-It-Yourself ... 66
Dogs, Birds, Hamsters & Pets ... 17

Earthworms, Crickets, Frogs ... 18
Educational & Instruction ... 45
Electric Trains ... 64B
Electrical Supplies & Equipment ... 7
Employment Information ... 42
Engines, Motors, Etc. ... 10

Farms, Other Real Estate ... 19
Field Glasses, Telescopes ... 14
For Inventors ... 60
For Parents ... 70A
For Sale Miscellaneous ... 71
For the Home ... 69
Formulas, Plans, Etc. ... 39

Gifts ... 49
Government Surplus ... 11A

High-grade Salesmen ... 44
Hobbies, Collections ... 31
Home Craftsman ... 65
Hypnotism ... 24

Import-Export ... 38B
Inventions Wanted ... 61
Investments ... 37A

Jokes, Games, Novelties, Etc. ... 24A

Language Outfits ... 48
Loans By Mail ... 80B

Machinery, Tool Supplies, Etc. ... 9
Magic Tricks, Puzzles, Etc. ... 25
Minerals & Precious Stones ... 30
Miscellaneous ... 79
Models, Model Supplies ... 64
Moneymaking Opportunities ... 38
Motion Pictures & Color Slides ... 33
Motorcycles, Bicycles & Supplies ... 4
Musical Instruments and Song Writers ... 35

Of Interest To Women ... 70
Old Gold, Jewelry, Watches ... 67

Personal ... 80
Phonograph Records ... 35A
Photo Finishing, Photocopies, Etc. ... 32
Plastics ... 40
Printing, Multigraphing, Etc. ... 57
Printing Outfits, Supplies ... 58
Profitable Occupations ... 22

Radio, TV, Electronics, Hi-Fi ... 36
Remailing Service ... 80A
Rubber Stamps & Office Supplies ... 56

Science & Chemistry ... 41
Special Services ... 51
Sporting Goods, Guns, Fishing Tackle, Etc. ... 15
Stamp Collecting ... 28

Tattooing Supplies ... 75
Taxidermy ... 13
Tobacco & Pipes ... 68
Treasure Finders & Geiger Counters ... 77
Trees, Shrubs, Roots & Herbs ... 20
Typewriters & Office Machines ... 55

Wanted to Buy ... 72
Watch Repairing ... 78
Wearing Apparel ... 73
Welding, Soldering ... 8

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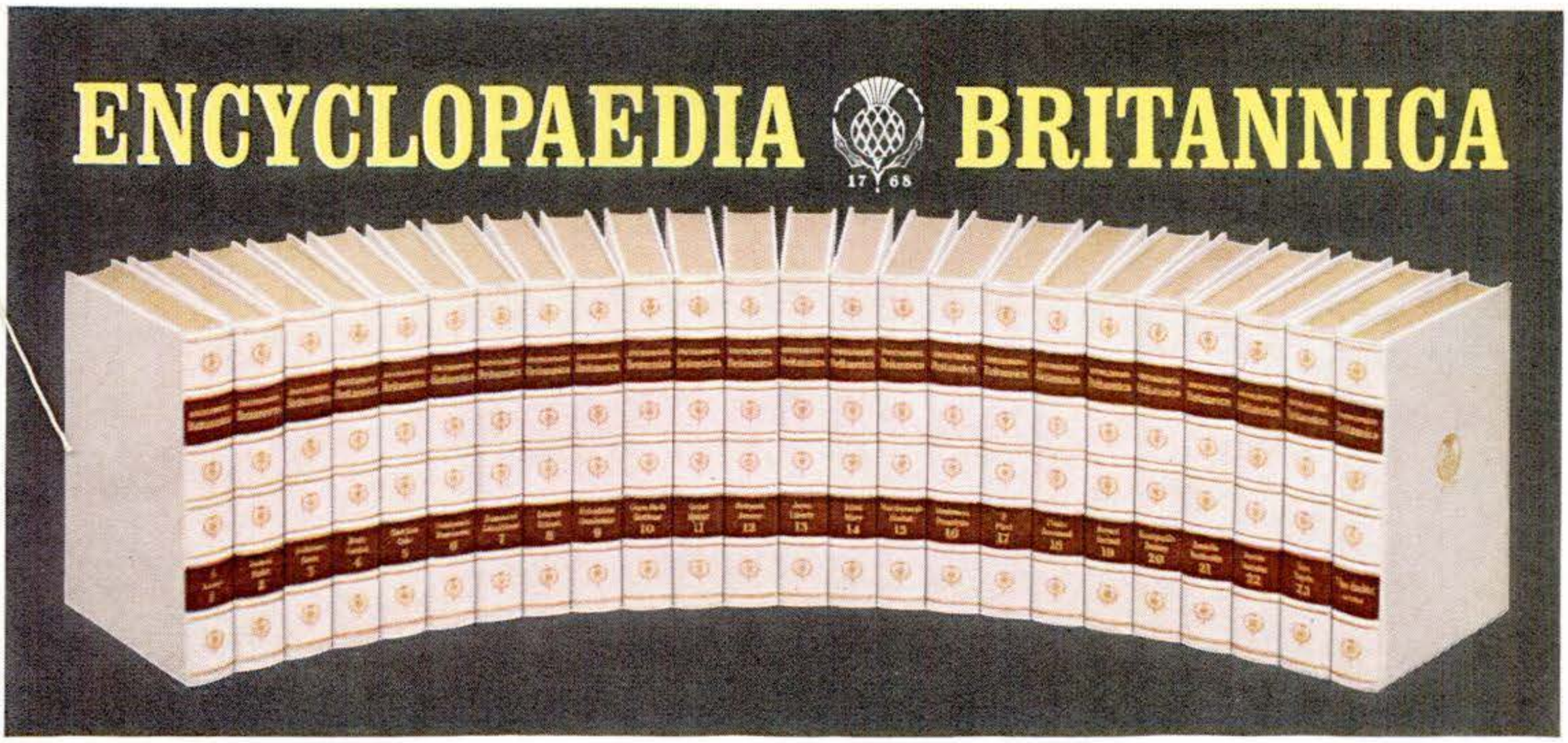

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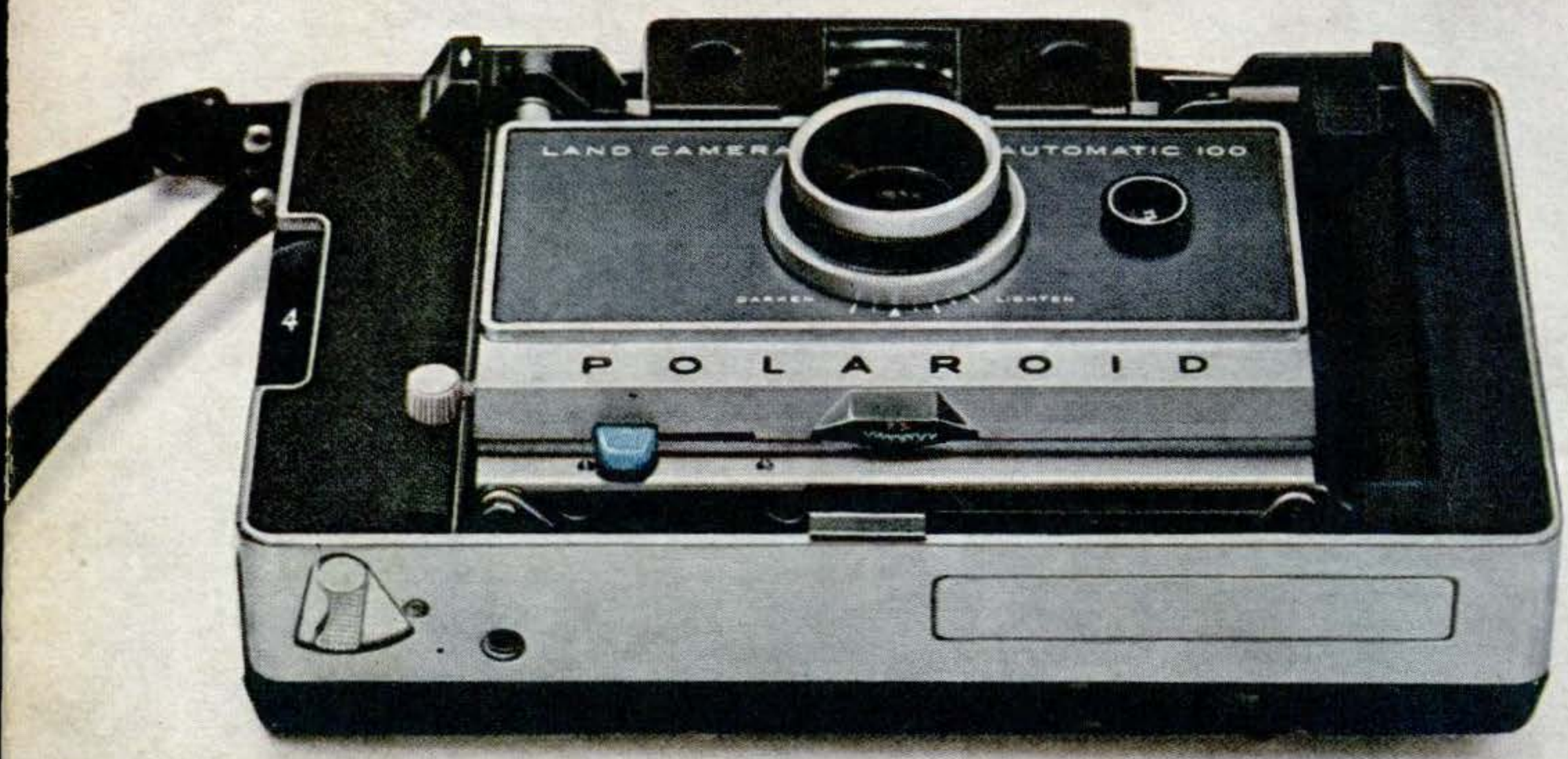

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